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THE

PRACTICE OF OBSTETRICS

BY

AMERICAN AUTHORS.

EDITED BY

CHARLES JEWETT, M.D.,
PROFESSOR OF OBSTETRICS AND GYNECOLOGY IN THE LONG ISLAND COLLEGE HOSPITAL, NEW YORK.

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PREFACE TO THE SECOND EDITION.

THAT the first edition of this work, published two years ago, has been exhausted within so short a time, is gratifying evidence of professional approval. In the present edition extensive revisions have been made and many new illustrations have been introduced, most of them original. Among the more important alterations are those pertaining to the pathology of pregnancy and to obstetric surgery.

The work of our late colleague Dr. W. W. Browning has been taken up by Dr. A. T. Bristow. Important changes have been made in the text of this chapter to conform to recent developments, and it has been enriched with new and original plates in colors and in black and white.

Two of the chapters originally contributed by the late Dr. J. H. Etheridge have been rewritten by Dr. M. A. Crockett, and the other three have been rewritten by the Editor.

Acknowledgment is due the original authors for their continued interest in the work and to those who have reinforced the corps of contributors. The Editor is indebted to Dr. C. R. Hyde for valuable assistance in revision of the chapter on Anomalies and Diseases of the Breasts and Nipples, and to Dr. H. P. de Forest for the skill and accuracy with which he has prepared the index.

CHARLES JEWETT.

OCTOBER, 1901.

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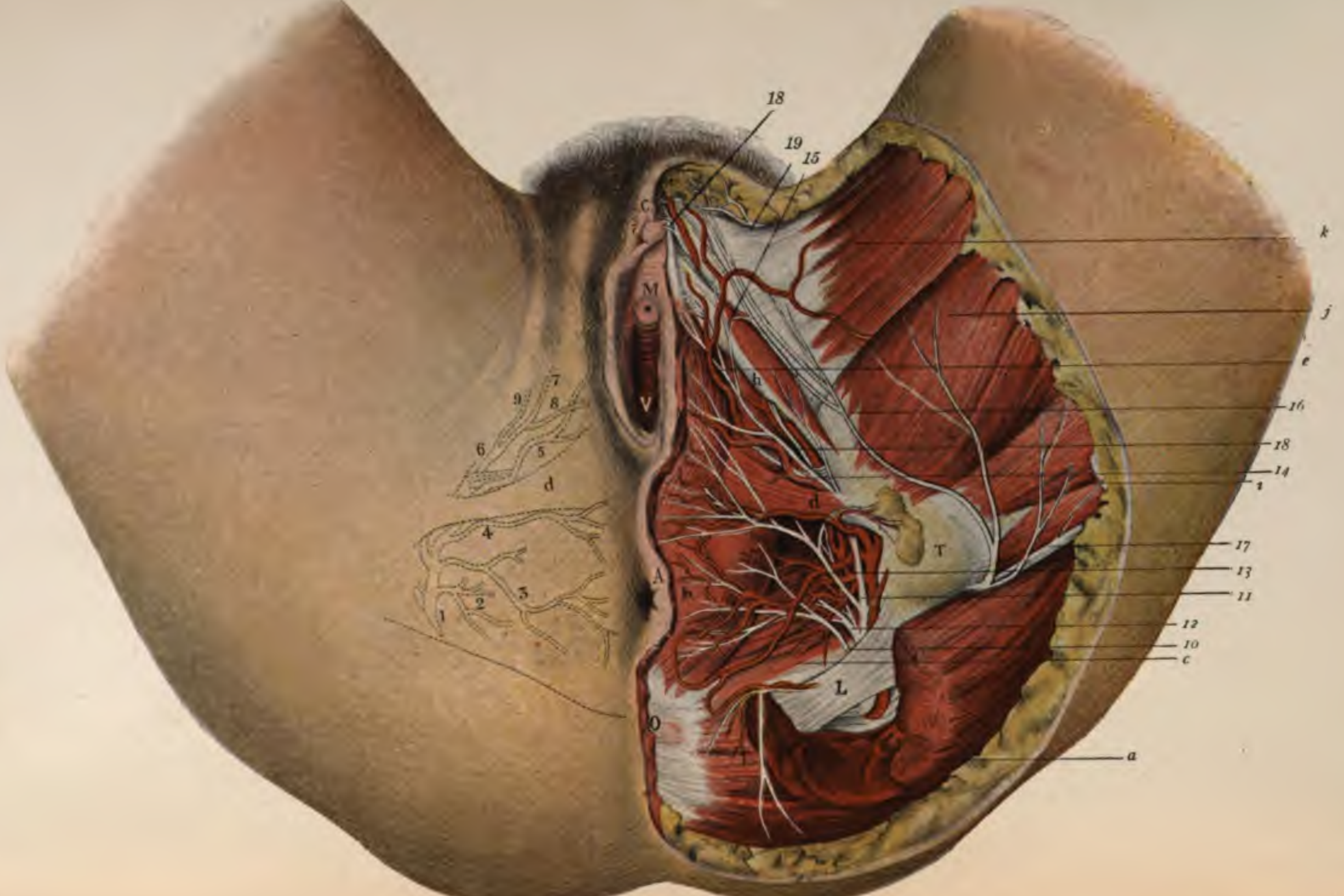
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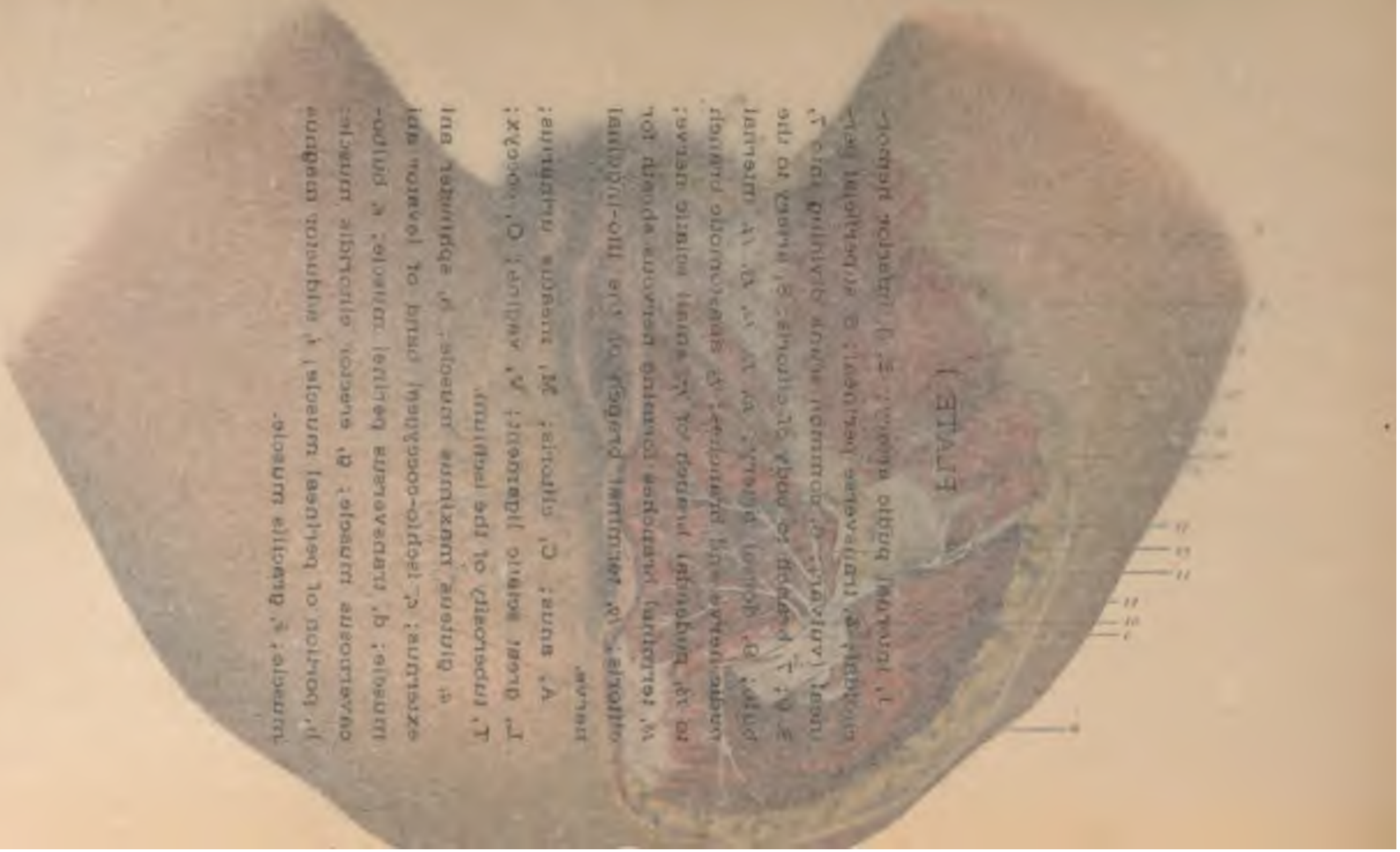
PLATE I.

1, internal pudic artery; 2, 3, inferior hemorrhoidal; 4, transverse perineal; 5, superficial perineal (vulvar); 6, common trunk dividing into 7, 8, 9; 7, branch to body of clitoris; 8, artery to the bulb; 9, dorsal artery; *10, 11, 12, 13, 14,* internal pudic nerve and branches; *15,* anastomotic branch to *16,* pudendal branch of *17,* small sciatic nerve; *18,* terminal branches forming nervous sheath for clitoris; *19,* terminal branch of the ilio-inguinal nerve.

A, anus; C, clitoris; M, meatus urinarius; L, great sciatic ligament; V, vagina; O, coccyx; T, tuberosity of the ischium.

a, gluteus maximus muscle; b, sphincter ani externus; *c,* ischio-coccygeal band of levator ani muscle; d, transversus perinei muscle; *e,* bulbo-cavernosus muscle; g, erector clitoridis muscle; h, portion of perineal muscle; *i,* adductor magnus muscle; *k,* gracilis muscle.

PLATE I



PRACTICE OF OBSTETRICS.

PART I.

ANATOMY.

CHAPTER I.

THE FEMALE PELVIC ORGANS.

THE female organs concerned in reproduction are located in the pelvis. They are usually classified as *external* and *internal*. The external organs include the mons Veneris, the labia majora, the labia minora, the clitoris, and the vaginal orifice. To them collectively is applied the designation *pudendum*. The term "vulva" includes all of the external organs except the mons Veneris. The internal organs are the vagina, the vaginal bulbs, the uterus, the Fallopian tubes, and the ovaries. The ovaries are concerned in germination, the tubes in fecundation, the uterus in gestation, and the remaining organs in copulation.

The terms "external" and "internal," as applied to the organs of generation, have no scientific value. They are retained merely for convenience of description. (Plate I.)

The Perineal Space. If the female be placed upon the back, with the legs flexed and the thighs flexed, abducted, and rotated outward, the perineal space will be exposed. Its landmarks may be made out by palpation. They are the tip of the coccyx, the subpubic arch, and the tubera ischiorum. From the pubic arch to the tuberosity of the ischium upon each side the boundary is bony. It consists of the descending ramus of the pubis and the ramus of the ischium. From the tuberosity of the ischium to the coccyx the boundary is an imaginary line. It corresponds, approximately, to the lower border of the gluteus maximus muscle. It should be observed that the gluteal fold does not coincide with this border, as is sometimes stated.

The Mons Veneris. Above the subpubic arch is an elevated mass of tissue, triangular in outline. The apex of the triangle points toward the perineal space; the base is marked by a fold of skin extending transversely across the hypogastrium; the sides correspond with the folds of the groins. This is the *mons Veneris*. The skin over the mons Veneris is thick. After puberty it is covered with a growth of coarse, curly hair, of a color somewhat darker than that upon the scalp. Underlying the skin is a quantity of areolar tissue continuous with the superficial fascia of the abdomen, of the thighs, and of the labia majora. It differs from the fasciæ in those regions, however, in possessing greater firmness and elasticity—qualities imparted to it by fibrous bonds or trabeculæ, containing a certain proportion of elastic elements, by which it is traversed. The mons Veneris serves a purely mechanical purpose, and is of interest to the obstetrician as a landmark only.

The Perineum. In the median line of the perineal space appears the anus and the cleft of the vulva. They are about 2.5 cm., 1 inch, apart. The area between the anus and the vulva is, by obstetricians, designated the *perineum*. The skin here is thin, deeply pigmented, and marked by a median raphe along which it is closely adherent to the underlying structures. A raphe, less noticeable, may also be observed extending from the anus to the coccyx. The skin in this situation is not so deeply pigmented nor so closely adherent to the underlying structures as is that over the perineum.

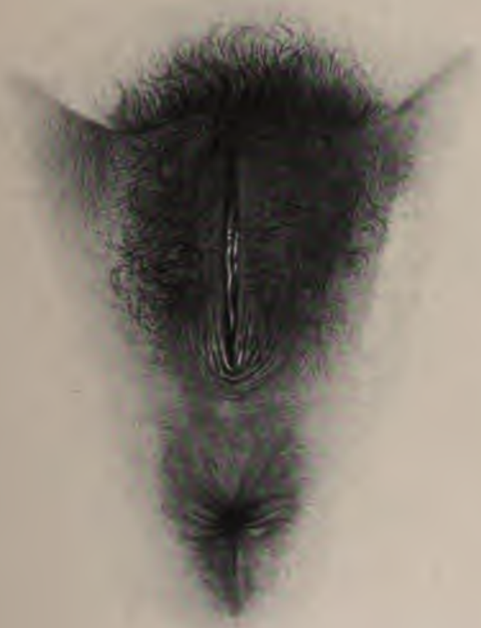
For convenience of description the perineal area is divided by an imaginary transverse line into an anterior, genito-urinary, region, and a posterior, ischio-rectal, region. The dividing line is drawn across the perineum joining the tubera ischiorum; it presents a slight concavity toward the anus.

The Labia Majora. Flanking the cleft of the vulva (*rima urogenitalis*) are the labia majora. Together they are analogous to the scrotum in the male. At the mons Veneris they meet, constituting the *anterior commissure*. Below they merge into the skin of the perineum. To the skin of the perineum limiting the cleft of the vulva the name *posterior commissure* has been applied. Each labium may be compared to a three-sided pyramid. The base is continuous with the mons pubis; the apex is at the perineum; one surface rests upon the pubic ramus, one looks outward toward the thigh, and one looks inward toward its fellow of the opposite side. The outer surface is convex. It is covered with coarse skin, over which extends the growth of hair from the mons pubis. The inner surface is also covered with skin, but of a different character. It is thin and moist and of a reddish color. It is covered with a growth of downy hair, to be seen upon close inspection only. Underlying the skin of the labium majus is a fascia containing fat. The fat is abundant near the mons, but diminishes toward the perineum. Continued into the fascia from the superficial fascia of the perineum is a stratum of elastic tissue. This may be traced as far as the margin of the external abdominal ring. Comparing this fascia with the dartos in the male, some anatomists claim to have demonstrated in it the presence of involuntary muscular fibres. By reason of the presence of the elastic and the muscular elements in the superficial fascia, the skin of the labium may present a corrugated appearance.

The round ligament of the uterus, after emerging from the external abdominal ring, is usually lost in the adipose tissue of the mons. It may extend into that of the labium. In some cases, though rarely, it carries with it a fold of peritoneum. The course of a pudendal hernia is thus accounted for.

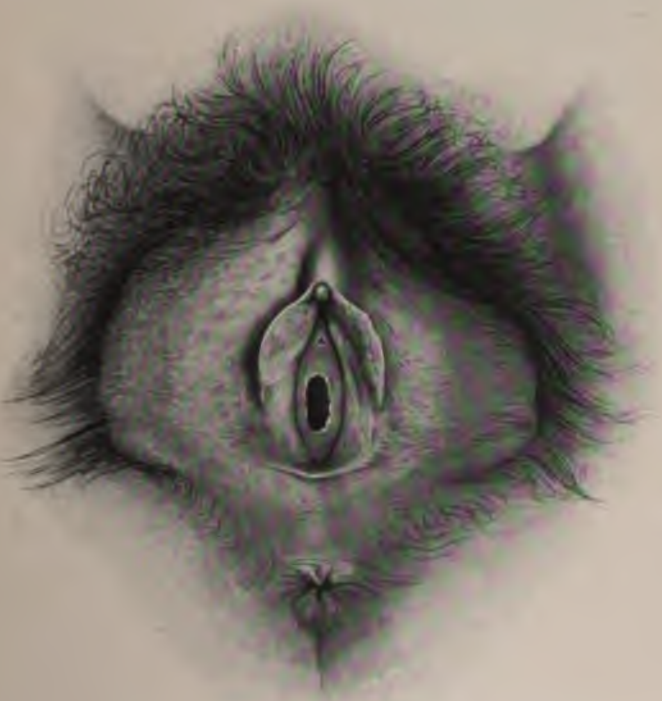
At birth there is a slight gaping of the labia majora owing to their incomplete development. In the well-nourished adult virgin they are

PLATE II.



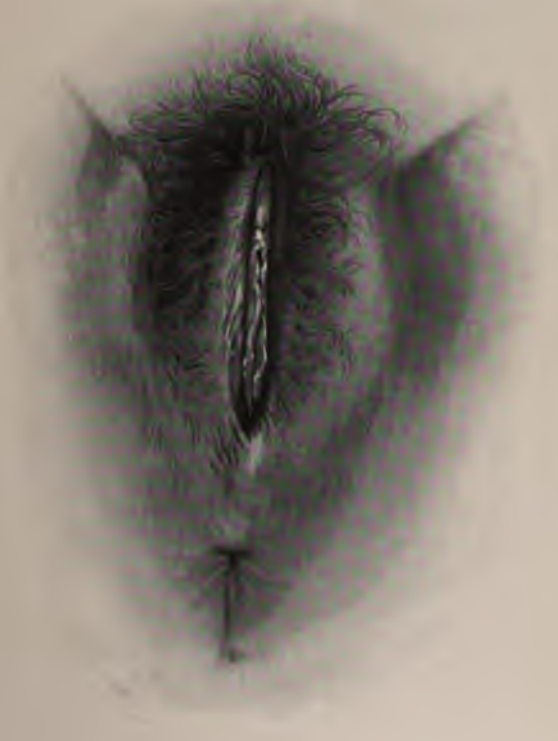
VULVA OF NON-PAROUS WOMAN, CLOSED

PLATE III.



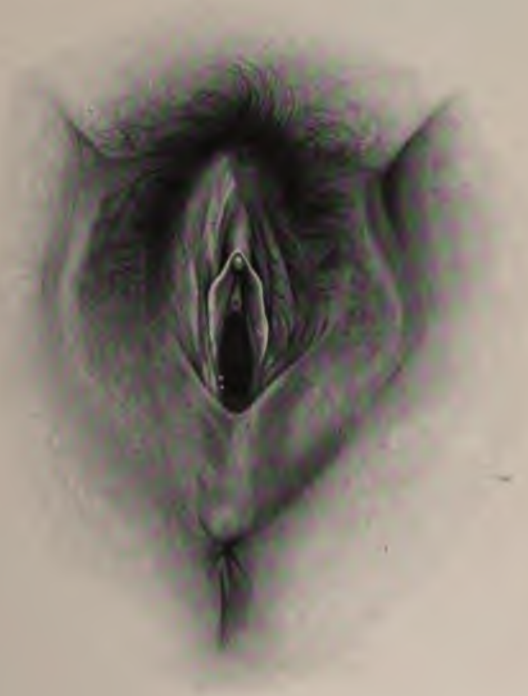
VULVA OF NON-PAROUS WOMAN, OPEN. HYMEN INTACT

PLATE IV.



VULVA OF PAROUS WOMAN, CLOSED

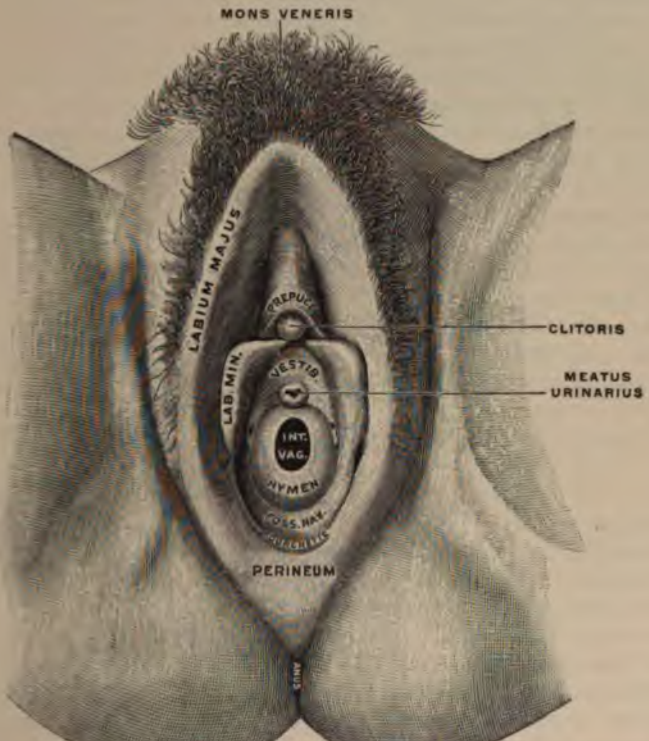
PLATE V.



VULVA OF PAROUS WOMAN, OPEN

usually in contact (*vulva connivens*), concealing from view the structures within. In the aged and emaciated they may gape (*vulva hians*), owing to waste of adipose tissue. They may be pressed apart by excessive development of the nymphæ.

FIG. 1.



Vulva of a virgin. The labia have been widely separated. (TESTUT.)

The Labia Minora. By separating the labia majora the *labia minora* or *nymphæ* may be brought into view. They are analogous to the skin of the penis in the male. Each nympha consists of an elongated triangular fold of modified integument. The bases unite medially above the clitoris, and the apices are lost in the labia majora at the sides of the ostium vaginæ. Each presents two surfaces and a free border. In the undisturbed condition of the parts the external surface is in contact with the labium majus of its own side, and the internal surface is in contact with the corresponding surface of the opposite nympha. At the glans clitoridis the free borders bifurcate. The upper divisions unite above that structure, forming a hood-like covering for it, known as its *præputium*, and the lower divisions unite below it, constituting its *frænulum*. The surfaces of the nymphæ are smooth and moist. Sebaceous glands exist upon the external surfaces, but hairs are nearly if not quite wanting. Upon the internal surfaces there are no hairs, and few if any sebaceous glands. A peculiar cheesy material known as *smegma* collects beneath the prepuce and upon the opposed surfaces of the labia minora. It is not a true sebaceous secretion, but is composed principally of cast-off pavement epithelium cells.

The underlying fascia of the nympha contains no fat, but supports a plexus of veins.

The labia minora, as has been already stated, are visible at the cleft of the vulva in the newborn. In the adult virgin they are pink in color, uniform in size, have unindented borders, and are concealed from view in the undisturbed position of the parts. From frequent copulation, and especially by childbearing, they undergo great changes in shape and appearance. They may assume a bluish color and become pigmented. They may become unevenly elongated and lobulated, and may protrude from between the greater labia. They may also lose their resemblance to mucous membrane and present the appearance of true integument.

The Fourchette. If the labia majora be widely separated, a transverse band of skin appears just above the posterior commissure. This is the *fourchette* or *frœnulum pudendi.* When thus demonstrated, a boat-like depression is artificially created between it and the ostium vaginæ. To this has been given the name *fossa navicularis.* Curiously enough, Quain and other well-established authorities describe the fossa navicularis as located between the fourchette and the posterior commissure. There seems, also, to be a difference of opinion as to the histology of the fourchette. Lusk, Skene, and others, following the conclusions of Luschka, describe it as the posterior commissure of the nymphæ. Commonly it is described as a transverse band derived from the labia majora. This discussion, however, is of more interest to the anatomist or medical jurist than to the obstetrician, since the integrity of the fourchette rarely survives the first parturition.

Vessels and Nerves of the Pudendum. The labia majora and the labia minora receive their vascular supply from the superficial perineal branches of the internal pudic arteries. These branches are larger than the corresponding vessels in the male, but they follow similar courses. Each branch arises from the parent trunk near the tuber ischii. It runs along the ramus beneath the superficial perineal fascia to the labium, where it anastomoses with the pudic branch of the femoral artery.

The veins of both the labia majora and the labia minora form rich plexuses which communicate freely with those of the vaginal bulbs. They empty by trunks which accompany the arteries above named. Those of the nymphæ are firmly supported by elastic and by smooth muscular tissue. They become turgid during sexual excitement. They do not, however, as is sometimes erroneously stated, constitute an erectile tissue. The veins of the labia majora are more loosely supported. They frequently present troublesome varicosities during pregnancy. They communicate with the veins of the round ligament of the uterus.

The lymphatics of the vulva empty for the most part into the inguinal glands. A few in the neutral territory between the nymphæ and the vagina may find their way to the femoral chains.

The nerve-supply of these structures is from the internal pudic and the lesser sciatic nerves. The former accompany the arteries of the same name. As they become superficial in the upper part of the perineal space they inosculate with the inferior branches of the lesser sciatic nerves.

Peripheral filaments are richly supplied to the præputium clitoridis, which is regarded by some writers as the seat of voluptuous sensation.

The Vestibule. The separation of the labia minora discloses a space in which may be seen the orifice of the vagina (*introitus* or *ostium vaginæ*). The space is lozenge-shaped. Above it is bounded by the nymphæ as they converge and unite at the frænulum clitoridis. Below it is flanked by the labia majora as they meet at the posterior commissure. The ostium vaginæ is in the lower half of this space. Between it and the posterior commissure are the fossa navicularis and the fourchette. The space above the anterior margin of the vaginal opening is triangular in outline. Some observers claim to have discovered a distinct line of demarcation between the modified skin of the nymphæ and the mucous lining of the genito-urinary tract. Though difficult of ocular demonstration, such a dividing line undoubtedly exists. It is described as following the attached border of the internal surfaces of the nymphæ, crossing beneath the frænulum clitoridis above and skirting the posterior margin of the ostium vaginæ below. To the portion of the space thus bounded, anterior to the ostium vaginæ, is given the name *vestibule.* The floor of the vestibule is marked by faint transverse ridges. For this and other reasons it may be regarded as a continuation forward of the anterior vaginal wall.

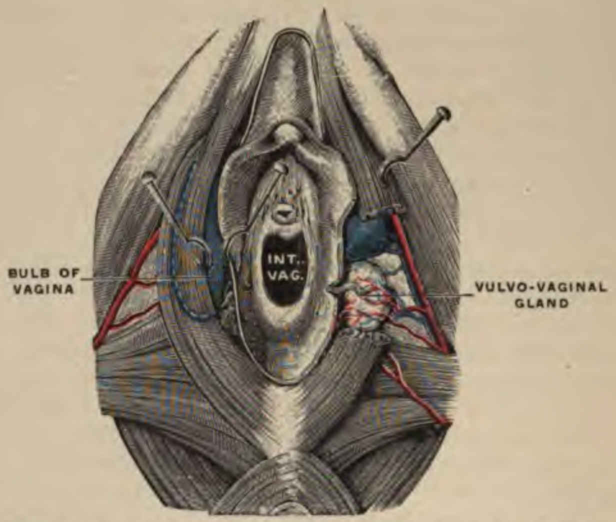
The Meatus Urinarius. In the median line of the vestibule, within 1 cm., ½ inch, from the vaginal orifice and about 2.5 cm., 1 inch, from the clitoris, may be observed the opening of the urethra. Its site is marked by an elevation of mucous membrane. This is more prominent anteriorly and has been accepted as a guide for passing the catheter by the sense of touch. As a result of frequent coition, and especially after parturition, this landmark is so far obliterated as to render it of doubtful value as such. The puckering of the mucous membrane about the urethral opening is caused by the presence of unstriated muscular fibres. A ring of such tissue has been described by Luschka surrounding the ostium vaginæ and the urethra, which is here embedded in the anterior vaginal wall. To it has been given the name *sphincter vaginæ.* Near the meatus urinarius may be seen the openings of several large mucous crypts. They are the *glandulæ vestibuli minores.* They may be so large as to admit the tip of a catheter. Otherwise the mucous membrane of the vestibule resembles that in other parts of the body.

The Glands of Bartholin. Situated at the sides of the vagina near its orifice are two glandular bodies, one upon each side. They are analogous to Cowper's glands in the male, and are named the *glands of Bartholin* or *of Duverney.* Like its analogue, each gland usually lies between the two layers of the triangular ligament. In a very large proportion of instances, however, it is superficial to both layers of the ligament. In either case it is more deeply situated than the vaginal bulb, by the posterior, rounded, extremity of which it is slightly overlapped.

The glands of Bartholin vary in size in different individuals, and frequently upon the two sides in the same person. They attain their greatest development in young adults of voluptuous propensities. They become flattened by childbearing. Like Cowper's glands, they belong to the compound racemose variety. They are of a reddish color and of the form and average size of a common white bean. Each gland is supplied with a duct about 15 mm., $\frac{5}{8}$ inch, in length and 3 mm., $\frac{1}{8}$ inch, in diameter. This passes obliquely forward or curves round the extremity of the bulb to open between the labium minus and the attached border of the hymen. The duct at its orifice is contracted and can with difficulty be discovered. Its location, however, is usually marked by a vascular area, and may be the better revealed by pressing aside the hymen or the caruncula myrtiformis.

From their location and that of their ducts, the glands of Bartholin are also denominated the *vulvo-vaginal glands*. They are active during sexual excitement only, at which time they secrete a yellow viscid fluid, which serves a purely mechanical purpose. They do not develop till puberty, and they become atrophied in the aged.

FIG. 2.



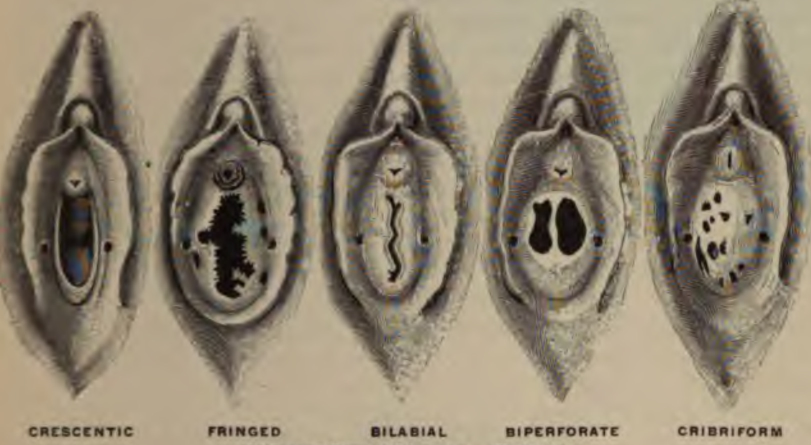
The vulvo-vaginal gland or gland of Bartholin. (The dotted line indicates the limits of the bulb of the vagina. (Testut.)

The deep perineal arteries supply the glands of Bartholin.

The Hymen. The vaginal orifice varies in appearance in different individuals. In the virgin it is partially closed by a structure known as the *hymen*. The hymen is a reduplication of the most inferior portion of the vaginal walls. It, therefore, consists of connective tissue supporting bloodvessels and covered by mucous membrane. Elastic and muscular tissue as well as nerve-fibres may be demonstrated within it. As a rule, it springs from the posterior and the lateral vaginal walls only. In exceptional cases the anterior wall contributes also to its formation. It, therefore, presents a variety of forms. (Fig. 3.) It may completely occlude the vagina (*imperforate*). It may be perforated by numerous small openings (*cribriform*). It may present a central longitudinal cleft. Its common form, however, is crescentic, the free concave border looking toward the anterior vaginal wall. Being crowded inward, it lies in folds, giving to it a fluted appearance.

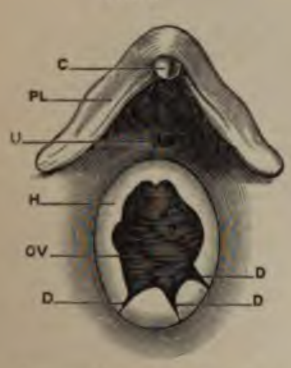
Usually the hymen is more or less lacerated at the first coitus. (Fig. 4.) Almost without exception it is obliterated at parturition. Thereafter nothing remains of it but fleshy tags attached about the entrance to the vagina. (Fig. 5.) These are called *carunculæ myrtiformes.* From the medico-legal stand-point the absence of a hymen furnishes *prima facie* evidence only of sexual indulgence. The converse of this proposition is also true. It may be absent in the virgin, and has been known to persist in the parous woman. On the other hand, carunculæ myrtiformes are undeniable evidence of a former parturition.

FIG. 3.


CRESCENTIC FRINGED BILABIAL BIPERFORATE CRIBRIFORM

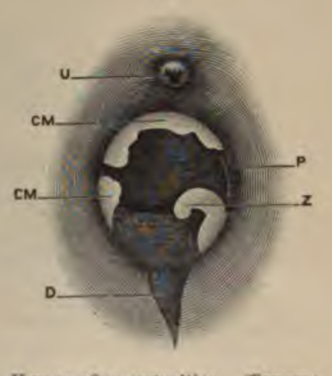
Different forms of hymen. (TESTUT.)

FIG. 4.



Hymen after coitus. (TESTUT.)

FIG. 5.



Hymen after parturition. (TESTUT.)

FIG. 4.—C. Clitoris. PL. Nymphæ. U. Meatus urinarius. OV. Vaginal orifice. H. Hymen. D. Rent in hymen.

FIG. 5.—U. Meatus urinarius. P. Nympha. CM. Carunculæ myrtiformes. Z. Portion of hymen, detached and floating. D. A tear through the fourchette.

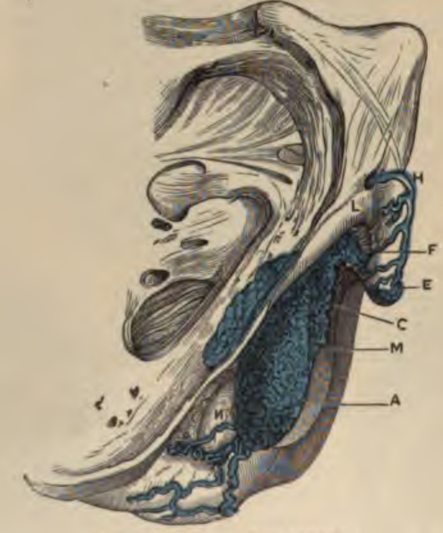
When the hymen is intact the exposed ostium vaginæ appears as a vertical slit. When it is destroyed the anterior and posterior vaginal walls are seen to be in contact. The remains of the hymen, however, may be traced about the orifice in a ring, which is laterally compressed as the vulva is allowed to close. This form of the ostium vaginæ is maintained, no doubt, by the arrangement of the muscular fibres of the pelvic floor.

The Glans Clitoridis. Just above the apex of the vestibular triangle may be seen the *glans clitoridis* surrounded by its prepuce. In the non-turgid condition it is a mere papilla. Frequently it is entirely hidden from view by an elongated prepuce. Occasionally the prepuce is adherent to it, rendering it still more difficult of demonstration. When turgid during sexual excitement it is rarely as large as a small pea.

The glans is the only part of the clitoris which is visible on inspection of the genitalia. It is covered by a modified skin which is extremely delicate and sparingly supplied with sebaceous glands. Sebaceous glands, however, are well developed about its circumference, and secrete an oily substance which emits a characteristic odor.

The Clitoris. The clitoris is not the analogue of the penis, as is so often stated. It corresponds rather to the glans, corpora cavernosa, and crura of that organ. When erect it may be felt, like a rounded cord, about 2.5 cm., 1 inch, in length and 5 mm., $\frac{1}{5}$ inch, in diameter. It arches upward from the apex of the vestibular triangle to the summit of the subpubic arch. (Fig. 6.) It consists of glans, corpora cavernosa, and crura, in structure similar to the corresponding parts of the penis, but of diminutive size. The trabeculæ of the cavernous bodies are firmer than those in the male organ. The glans is imperforate, and is formed of a plexus of veins continued into it from the bulbs of the vagina. It will be noticed that the corpora cavernosa are formed of true erectile

FIG. 6.



The clitoris. (After KOBELT.)

A. Bulbus vestibuli. C. Pars intermedia. E. Glans clitoridis. F. Corpus clitoridis. H. Dorsal vein. L. Right crus. M. Vestibule. N. Gland of Bartholin.

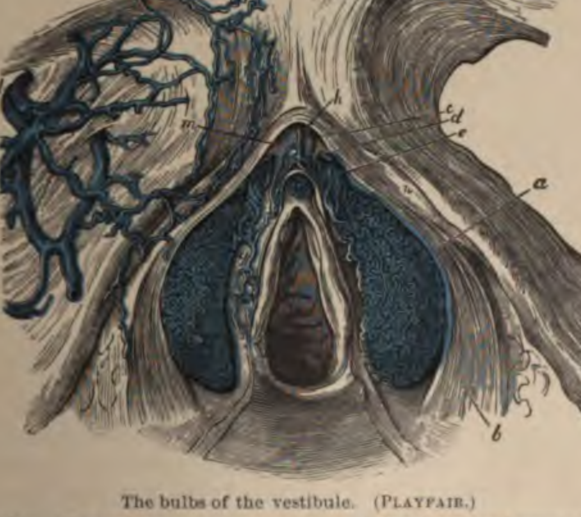
tissue. Not so the glans, though it becomes turgid during the erection of the clitoris.

The clitoris, like its analogue, is furnished with a suspensory ligament. Its mobility, however, is greatly limited by the attachments of the prepuce and of the frænulum.

The vessels supplying the clitoris are disposed in the same manner as the corresponding ones in the male. The same may be said of the lymphatic canals. The nerve-supply to the organ is proportionately much more abundant than that of its analogue. Its source is both from the internal pudic nerves and from the hypogastric plexus of the sympathetic. Nerves from both these sources communicate freely in the organ and form an especially rich network upon the glans. Their method of termination is similar in both sexes.

The Bulbs of the Vagina. Located at the sides of the vagina are the *vaginal bulbs*, more commonly designated the *bulbs of the vestibule*. (Fig. 7.) They are analogous to the bulbous portion of the corpus spongiosum in the male. They lie between the constrictor vaginæ muscle and the anterior layer of the triangular ligament. Relying upon the usual illustrative drawings, one would certainly be disappointed in their appearance, unless an artificially injected specimen were to be examined. Each bulb consists of a plexus of large veins enclosed within a fibrous capsule. When injected it is about 2.5 cm., 1 inch, in length and 12 mm., ½ inch, at its greatest breadth. It is flask-shaped, the bottom of the flask being on a line with the points where the labia minora disappear at the sides of the ostium vaginæ. Anteriorly the

FIG. 7.



The bulbs of the vestibule. (PLAYFAIR.)

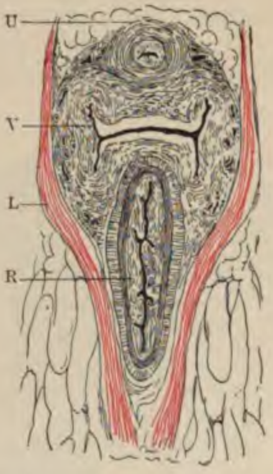
a. Bulb of vestibule. b. Muscular tissue of vagina. c, d, e, f. The clitoris and muscles. g, h, i, k, l, m, n. Veins of the nymphæ and clitoris communicating with the epigastric and obturator veins.

bulbs taper and communicate with each other beneath the clitoris. The isthmus of communication is known as the *pars intermedialis* of Köbelt. The veins of the bulbs communicate freely with the plexuses of the nymphæ and of the labia majora, and also with those making up the substance of the glans clitoridis.

The bulbs of the vagina, though becoming turgid during sexual excitement, do not constitute a true erectile tissue. When turgid they encroach upon the space between the pubic rami, and thus narrow the vaginal orifice.

The Vagina. The vagina is usually described as a musculo-membranous canal leading from the vulva to the uterus. Lying as it does between the bladder and the rectum, its axis varies according to the fulness or emptiness of these viscera. Its axis is also dependent upon the condition of the pelvic floor. With the pelvic floor intact and with the bladder and the rectum empty, the axis of the vagina is nearly parallel with the pelvic brim, except that its lower portion is bulged forward by the perineal body. It is evident that its axis will be rendered more nearly horizontal by a distended bladder and more nearly vertical by a full rectum. In the virgin, in whom the hymen is still intact, the vaginal opening appears as a vertical slit. When, however, the hymen has been destroyed the anterior and the posterior walls of the vagina are seen to be in contact, and upon cross section its lower end presents an outline resembling the capital letter H. The ostium is much the narrowest part of the canal, even when the latter is distended. A cast of the distended vagina has the shape of an inverted truncated cone, and that this is the shape of the canal may be demonstrated by exploring it with the subject in the genu-pectoral position. The upper expanded portion has been designated the *fornix* or *vault*. Into it from above projects the cervical segment of the uterus. The recesses in front of,

FIG. 8.

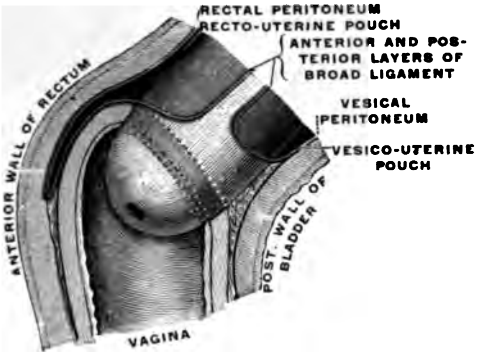


Transverse section of the lower portion of the vagina. (HENLE.)
L. Levator ani muscle. R. Rectum. U. Urethra. V. Vagina.

behind, and at the sides of the cervix uteri are distinguished as the anterior, the posterior, and the lateral fornices.

Since the vaginal canal is usually in a collapsed condition, but two walls, the anterior and the posterior, demand description. From what has been already stated, it will appear evident that both walls are wedge-shaped and that the narrow extremities of the wedges are at the ostium vaginæ.

FIG. 9.

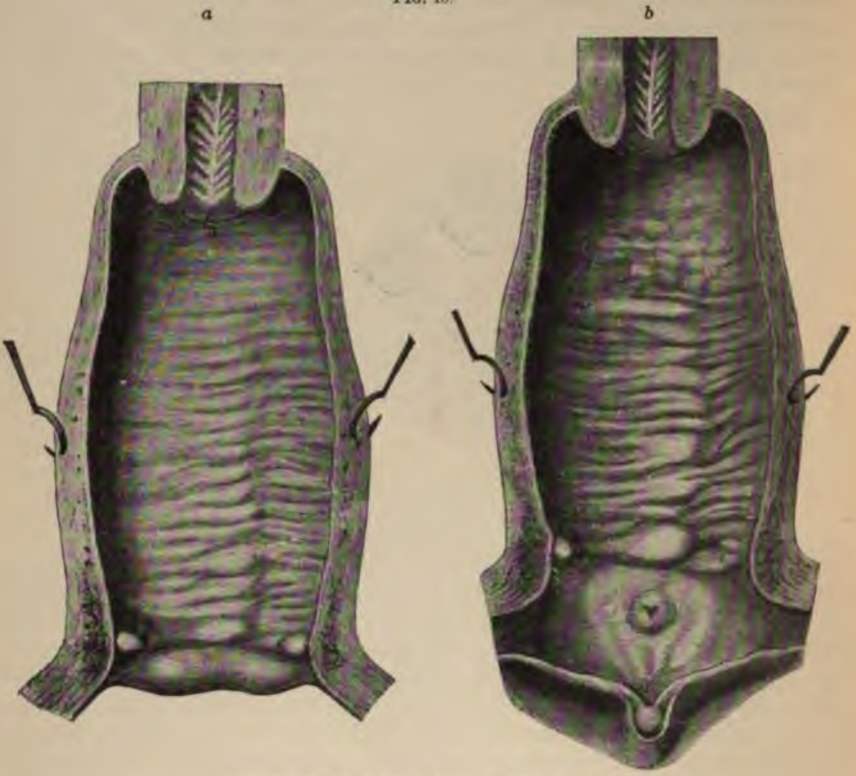


The neck of the uterus and the upper extremity of the vagina, showing their relation to the peritoneum (vaginal walls in red). (TESTUT.)

The capacity of the vagina is increased in every direction by child-bearing. In parous women it may have its greatest breadth through the middle; but, as a rule, it is broadest at the fornix. This breadth varies from 3.5 cm., 1½ inch, in nulliparæ to double this measurement in multiparæ. The length of the vagina varies in the different races and in different individuals of the same race. In the negress it is longer as well as more capacious than in women of the white race. Measurements are made along both the anterior and the posterior walls. The average length of the anterior vaginal wall in white women is 6 cm., 2½ inches, and of the posterior wall 8.5 cm., 3½ inches. The canal is not quite as long in virgins, and it undergoes shortening in senile involution. Cases of congenital shortening are not infrequently met with in which the canal is diminished to half its usual length. The difference in the lengths of the anterior and of the posterior vaginal walls may create the erroneous impression that the cervix uteri projects through the upper part of the anterior wall, and this impression is strengthened by the greater depth of the posterior fornix.

The vagina is a muscular organ lined by mucous membrane and surrounded by dense areolar tissue. This has led anatomists to describe it as having a fibrous, a muscular, and a mucous coat. Its walls vary in thickness from 5 mm. to 1 cm., ¼ to ½ inch. They are thinnest at the fornix and thickest where the urethra is embedded in the anterior wall. This difference in thickness is confined almost entirely to the muscular structure. The muscle is of the unstriated variety and has intermingled with its fibres a certain amount of elastic tissue. Muscular fibres may be made out, taking various courses, circular, longitudinal, and oblique. They interlace, however, in so intricate a manner as to be inseparable into distinct strata. They are continued into the muscular walls of the uterus above, and below are lost in the structure of the pelvic floor. It is a mistake to state that they are attached to the bony pelvis.

FIG. 10.



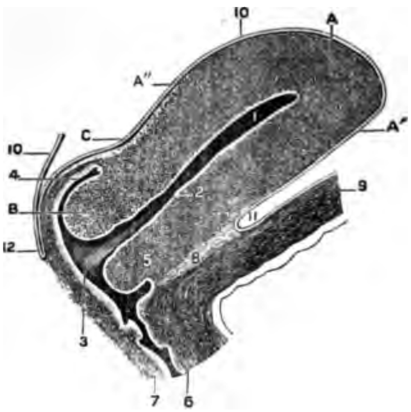
Longitudinal section of the vagina. (TESTUT.)

a. Segment showing posterior wall. *b.* Segment showing anterior wall.

The mucous membrane of the vagina is continuous with that of the uterus, and, inferiorly, it covers the hymen and the vestibule. Its epithelium is of the pavement variety. This variety of epithelium characterizes the mucous membrane of the intravaginal surface of the cervix uteri also. The vaginal mucous membrane is from 1 mm. to 1.5 mm. in thickness, and is closely adherent to the underlying muscular wall. In the lower half of the canal each wall is marked by a longitudinal median elevation or furrow—the *columna vaginæ*. This is flanked by transverse ridges—the *rugæ* or *cristæ vaginæ*. The column upon the anterior wall is most marked and seems to originate in the prominent mass of tissue surrounding the urethral opening. The cristæ, which are also best developed upon the anterior wall, are not to be considered as folds of the mucous membrane. They are not obliterated when the vagina is put upon tension, and are, no doubt, due to an alternate thickening and thinning of the mucosa. The markings upon the vaginal walls are most distinct in the infant and in the virgin. They are obscured by childbearing and by catarrhal inflammation.

A sparing secretion of mucus, acid in reaction, is found upon the vaginal walls. Its source is undetermined, since no glands have been demonstrated in the mucosa. The reaction of the secretion has been supposed to be due to the presence in it of an organism known as the *bacillus of Döderlein.* Recent investigation, however, has rendered this theory doubtful.

FIG. 11.



Sagittal section of the uterus to show the manner in which the peritoneum is attached.

A. Body of the uterus. A'. Anterior surface. A''. Posterior surface. B. Neck. C. Isthmus. 1. Cavity of the body. 2. Os internum. 3. Os externum. 4. Posterior fornix. 5. Anterior lip of cervix. 6. Anterior vaginal wall. 7. Posterior vaginal wall. 8. Vesico-uterine septum. 9. Wall of the bladder. 10. Peritoneum. 11. Vesico-uterine pouch. 12. Cul-de-sac of Douglas. (TESTUT.)

The muscular walls of the vagina are surrounded by fibro-cellular tissue. This serves to support a rich vascular network. The relation of the vagina to the tissues forming the pelvic floor has already been considered. A short distance above this floor the posterior vaginal wall comes in close contact with the rectum. This relation is maintained up to the line where the rectum receives its peritoneal covering. The structures between the two canals constitute the *recto-vaginal septum.* Anteriorly the vaginal fornix and the upper part of the canal itself are separated from the urinary bladder by a mass of loose connective tissue. This supports the vesico-vaginal plexus of vessels. The relation of the vagina to the urethra has been already described. The structures between the bladder and the vagina constitute the *vesico-vaginal septum.* Those between the lumen of the vagina and that of the urethral canal form the *urethro-vaginal septum.* Laterally the walls of the vaginal fornix are in relation with the bases of the broad ligaments.

From the foregoing description and that which has already been given of the vesico-uterine pouch it will be understood that the anterior fornix is separated by a considerable distance from the peritoneal cavity. Posteriorly, however, the peritoneum is reflected from the anterior rectal wall forward and upon the vagina. Thence it takes a course upward and to the uterus. The posterior vaginal wall below its attachment to the uterus is thus covered for a certain distance by peritoneum. This distance varies in length from 15 mm. to 3 cm., ¾ to 1¼ inch. Thus the posterior fornix is in close relation to a peritoneal recess between the rectum and the vagina, designated the *recto-vaginal pouch* or *cul-de-sac of Douglas*. Laterally the cul-de-sac is bounded by peritoneal folds reaching from the upper part of the cervix uteri to the sides of the rectum and past the rectum to the second sacral segment. These are the *folds of Douglas* or the *utero-sacral ligaments.*

In congenital shortening of the vagina copulation is difficult. However, the posterior wall of the vagina may become elongated by repeated acts of sexual congress, thus greatly distending the posterior fornix.

Prolapsus uteri and congenital shortening of the vagina should not be mistaken the one for the other, since in simple prolapsus the uterus may readily be replaced.

The Ischio-rectal Fossa. The ischio-rectal fossa in the female is broader and shallower than in the male; otherwise the anatomy of both is the same. Its form is pyramidal. It is bounded anteriorly by the perineal ledge, externally by the obturator fascia, and superiorly and internally by the anal fascia. It contains firm, coarse areolar tissue of low vascularity and, on that account, is frequently the seat of abscesses. This region is of practical interest to the obstetrician in so far only that in very fat women it may obstruct delivery.

It should be remembered that terminal branches of the pudic arteries and nerves approach the anus from before backward, crossing the external sphincter obliquely.

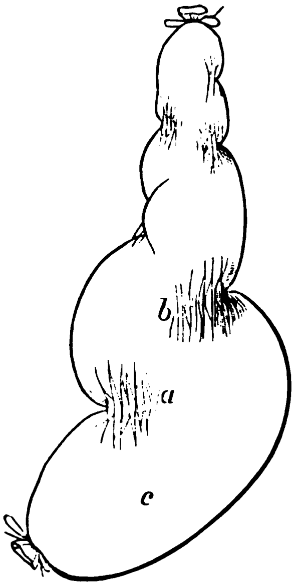
The Anus. About 2.5 cm., 1 inch, below the posterior commissure of the vulva appears the anus. It is the orifice of the bowel. The skin about the anus is exceedingly delicate and deeply pigmented. It is abundantly supplied with sebaceous glands and covered with a growth of hair. The hair does not grow as profusely, however, as in the male. The skin of the anus is prolonged into the bowel about 1 cm., $\frac{1}{3}$ inch. Owing to the presence in it of unstriated muscular fibres, it is thrown into radiating folds and presents a puckered appearance. To the muscular fibres has been given the name *corrugator cutis ani.*

The subcutaneous veins at the junction of the skin and the mucous membrane of the bowel are loosely supported. For this reason they frequently present varicose enlargements and protrude as *external piles.* The remains of these tumors may persist about the anus in the form of fleshy tags.

The Rectum. The *rectum* is that part of the intestinal tract which extends from the pelvic brim to the anus. At its commencement it lies upon the left sacro-iliac synchondrosis. Throughout its course it presents three well-marked curves. It first curves downward, backward, and toward the right to the hollow of the sacrum. Thence it curves forward to reach and to become attached to the posterior vaginal wall. It then leaves the vagina, from which it is separated in the rest of its course by the perineal body. The three curves are in length 9 cm., 7.5 cm., and 4 cm. respectively. The entire length of the canal is, therefore, about 20.5 cm., 8 inches. The rectum when empty occupies little of the pelvic space, but is capable of great distention. When distended at the time of parturition it may present an obstacle to delivery. Its most dilatable part is about 2.5 cm., 1 inch, above the anus, and is designated the *ampulla*. The portion extending from the ampulla to the anus is sometimes described as the *anal canal*.

The coats of the rectum are muscular and mucous and are united by submucous tissue. The mucous and submucous structures are similar to those of the colon, except that the former is more vascular. In the mucous coat may be distinguished two strata of unstriped fibres. The fibres of the external stratum are longitudinally disposed and uniformly distributed about the canal. The fibres of the internal stratum encircle the whole of the tube. About the anal canal, down to the external sphincter ani, the circular fibres are augmented so as to form a band 4 mm., $\frac{1}{6}$ inch, in thickness, and 18 mm., $\frac{3}{4}$ inch, in width. This constitutes the *internal sphincter ani* muscle. When the rectum is empty its anterior and posterior walls above the anal canal are in contact. Except when artificially distended or during defecation the anus is closed by tonic contraction of the internal sphincter.

FIG. 12.



Rectum inflated. (CHADWICK.)

a, *b*. Sphincter tertius. *c*. Ampulla.

Attention should be called to certain folds of the mucous coat not dissimilar to the valvulæ conniventes in the small intestine. Of these there are three which have been designated the *valves of Houston*. (Fig. 12.) They are arranged transversely or obliquely to the lumen of the tube, and remain unobliterated when it is distended. The longest of them (*plica-transversalis recti*) projects into the rectum from the right. It is about on a level with the cul-de-sac of Douglas. The two others project from the left wall. They are about 5 cm., 2 inches, apart and equally distant above and below the plane of that upon the opposite side. Feces may become impacted above these folds, which fact led Hyrtl to designate them "the third sphincter."

The hemorrhoidal veins are especially abundant in the submucosa. They communicate freely and empty into both the general and the portal circulation. In pelvic obstruction or congestion they may undergo varicose enlargement, and constitute *internal piles.*

The upper third of the rectum is completely invested with peritoneum. This is reflected upon it from as low down as the third sacral segment. The fold of membrane thus formed is denominated the *meso-rectum.* Anteriorly the peritoneum descends upon the rectum to within 6 cm., 2½ inches, of the anus, whence it is reflected upon the vagina. Thus is formed the *recto-vaginal pouch, or cul-de-sac of Douglas.*

The upper part of the rectum lies upon the pyriformis muscle and the sacral plexus of nerves. It has to its left side the left ureter and the left internal iliac artery. Below its peritoneal investment it is united to the sacrum and the coccyx behind, and to the levator ani muscles laterally, by areolar tissue.

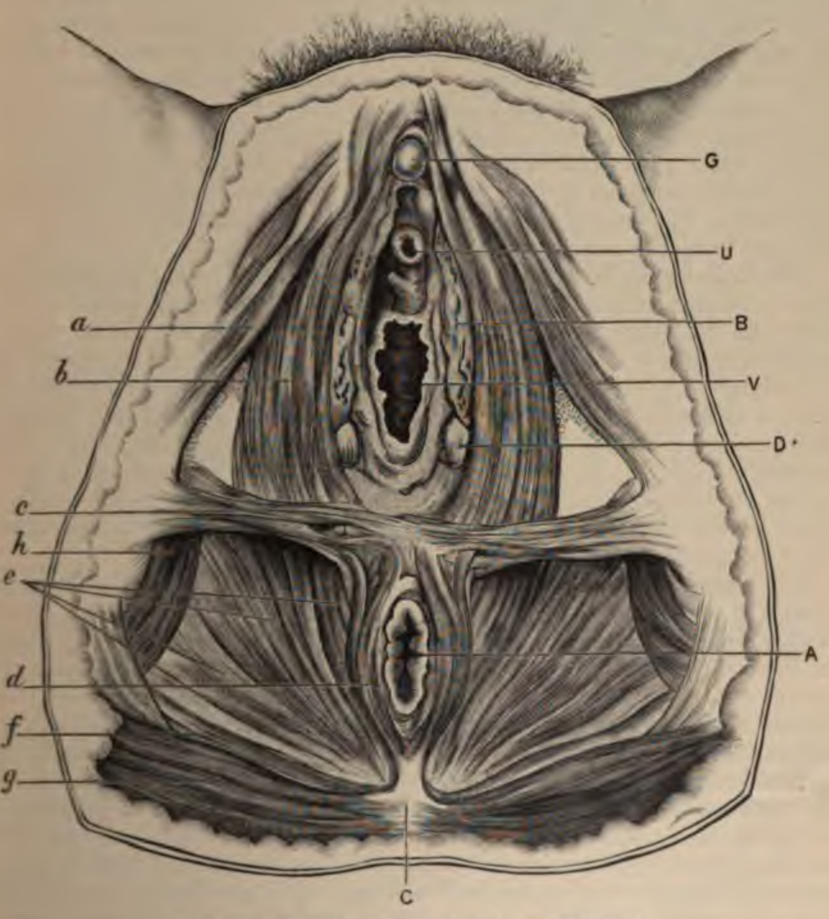
The Pelvic Floor. The pelvic floor consists of the skin, the fascia, and the connective tissue closing in the pelvic outlet, together with certain specialized bands of muscular fibres. It supports the pelvic viscera, none of which nor any part of the peritoneum should be considered as belonging to the floor itself; it is perforated by the rectum and by the vagina; in the anterior wall of the latter canal is the lower end of the urethra. The anatomy of the rectum and of the vagina will be considered later. They are musculo-membranous canals, the orifices of which have already been described as being about 2.5 cm., 1 inch, apart. Within the pelvis the canals approach so that their walls come in contact at about 4 cm., 1½ inch, from their orifices.

It may be well to remind the reader that the body is for the most part developed in symmetrical halves. There exists, therefore, a line of union between the lateral halves, and this is usually located in the median plane. Instead of speaking of the structures upon one side of this line as continuous with corresponding ones upon the other, it would be more nearly correct to speak of both as meeting in a median raphe. Inasmuch as vessels and nerves as they approach their terminations diminish in size, it follows that the median raphe is least vascular and least sensitive. (Fig. 13.)

The External Sphincter Ani Muscle. The skin and the fascia extending from the anus to the coccyx are closely adherent along the raphe. Together they constitute the *ano-coccygeal ligament.* From each side of this band or ligament, beneath the superficial fascia, thin, pale sheets of striated muscular fibres arise. They pass forward to blend with those of other muscles at the central point of the perineum, thus surrounding the anus elliptically. With deeper fibres derived from the pubic bands of the levator ani muscles they constitute the *sphincter ani externus* muscle. The function of the external sphincter is to keep the anus closed in response to the will during violent muscular exertions, such as coughing, sneezing, and the like. It forms a *point d'appui* for the other muscles of the perineum, and may aid in expelling the feces at the end of the act of defecation. Loss of its function does not of necessity result in incontinence of feces. The deep fibres derived from the levatores ani pass posteriorly to the anus. Traction upon them separately everts the anus.

The Superficial Fascia of the Perineum. The superficial layer of the superficial fascia of the anal and that of the genito-urinary regions are continuous with each other and with that of the rest of the body. In the genital area of the perineal space a deep layer of the superficial fascia may be demonstrated. It corresponds to Colles' fascia in the male. It is attached to the anterior margins of the descending rami of the pubes, and is continued upon the rami of the ischia as far as the tuberosities. Toward the central line it enters the labia majora, and in them may be traced to the external abdominal rings. Posteriorly it turns around the transversus perinei muscles to join the deep fascia. The deep fascia,

Fig. 13.



Muscles of the pelvic floor. (Modified, from Savage.)

A. Anus. B. Bulbs of the vestibule. C. Coccyx. G. Glans clitoridis. U. Meatus urinarius. V. Vagina. D. Glands of Bartholin. *a*. Ischio-cavernosus muscle. *b*. Bulbo-cavernosus. *c*. Transversus perinei. *d*. Sphincter ani. *e*. Levator ani. *f*. Coccygeus. *g*. Gluteus maximus. *h*. Obturator externus.

otherwise known as the *anterior* or *inferior layer of the triangular ligament*, will be described hereafter.

To expose the remaining muscles of the perineum the deep layer of the superficial fascia must be removed.

The Constrictor Vaginæ Muscle. The *constrictor vaginæ* muscle (sometimes also called the *sphincter vaginæ*) is the analogue of the accelerator urinæ or bulbo-cavernosus in the male. It exercises no such function as its name would suggest, but rather compresses the bulbs of the vagina, which it covers. The muscle consists of thin sheets of striated fibres located upon the sides of the vaginal opening which it thus surrounds. The fibres arise at the perineal body, being closely related to those of the external sphincter ani and of the transversus perinei muscles. Passing over the vaginal bulbs they converge somewhat and are inserted into the sheaths of the corpora cavernosa in front of the insertions of the erector clitoridis muscles. A slip crosses the clitoris and compresses the dorsal vein. It is claimed by Henle that some fibres may be traced into the posterior surfaces of the vaginal bulbs and some into the floor of the vestibule. The constrictor vaginæ muscle is separated by a considerable interval from the vaginal walls.

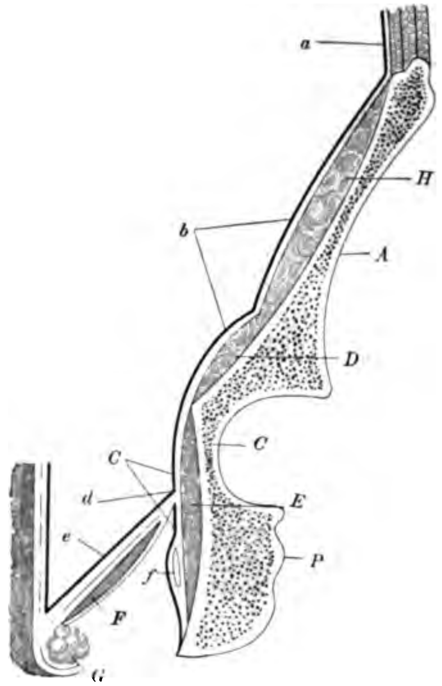
The Transversus Perinei Muscles. The *transversus perinei* or *ischio-bulbosus* muscles correspond to those of the same name in the male. They differ in that they are relatively smaller in the female. Each muscle arises from the inner surface of the ramus of the ischium just above the tuberosity and between the origins of the obturator internus and the erector clitoridis muscles. It is inserted into the base of the perineal body. The fibres intermingle at their insertion with those of the other muscles meeting at this point. A few fibres deeply situated are inserted in the vaginal wall and some join their fellows from the opposite side in front of the urethra. These latter are sometimes separately named the *deep transversus perinei* muscles.

The Erector Clitoridis Muscles. Internal to the origins of the transversus perinei muscles and somewhat nearer to the tuberosities of the ischia arise the *erector clitoridis* or *ischio-cavernosus* muscles. They are of reduced size as compared with their analogues, the erectores penis. As its name indicates, each is inserted into the corpus cavernosum. It is also inserted into the suspensory ligament. In its course it lies near the ramus of the ischium and the descending ramus of the pubis.

The Perineal Ledge. In the triangular intervals left upon each side between the three last-described muscles may be seen the deep fascia of the perineum. As has been already stated, it is also called the *anterior* or *inferior layer of the triangular ligament.* It consists of a sheet of fascia attached laterally to the ischiatic and the pubic rami and anteriorly to the pubic arch. Posteriorly to the transversus perinei muscles it unites with the deep layer of the superficial fascia. At their line of union these fasciæ are joined by the fascia lining the under surfaces of the levator ani muscles. Thus is formed the *perineal ledge.* The inferior or anterior layer of the triangular ligament is perforated by the vagina and the urethra, between which canals it sends a slip across the vestibule. It is, for this reason, a much weaker structure in the female than in the male.

The Pelvic Fasciæ. An almost complete partition exists between the superficial structures of the pelvic floor and the viscera of the pelvis. It is formed by sheets of fascia and by the levator ani and coccygeus muscles. Since its lateral halves are symmetrical, but one side will be described.

FIG. 14.



Coronal section of the pelvis. (BROWNING.)

A. Ilium. *P.* Ischium. *C.* Acetabulum. *D.* Psoas magnus muscle. *E.* Obturator externus. *F.* Levator ani. *G.* Sphincter ani externus. *a.* Transversalis fascia. *b.* Iliac fascia. *c.* Obturator fascia. *d.* "White line." *e.* Recto-vesical fascia. *f.* Alcock's canal.

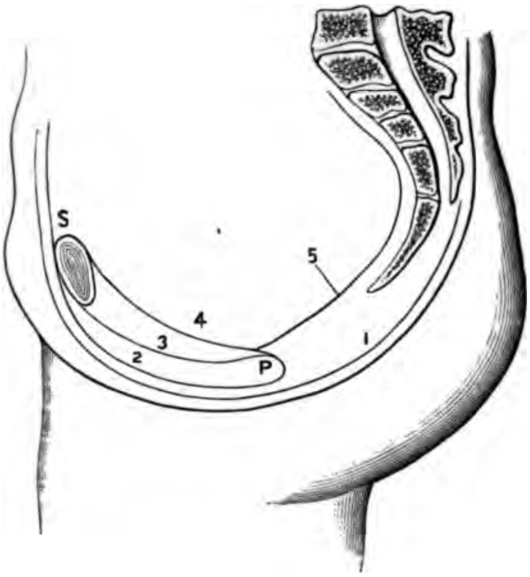
The *obturator internus* muscle arises from the lateral pelvic wall. It is attached to all but a small portion of the lower part of the obturator membrane. It has also a bony origin from the ramus of the ischium and the descending ramus of the pubis contiguous to the obturator foramen and from the bodies of the ischium and of the ilium. From this extensive origin its fibres converge to a tendon which leaves the pelvis through the lesser sciatic foramen. The *pyriformis* muscle arises from the antero-lateral aspect of the sacrum and passes out of the pelvis through the greater sciatic foramen.

The Obturator Fascia is continuous with the iliac fascia and with that covering the pyriformis muscle. Above it looks toward the pelvic cavity and below it forms the external boundary of the ischio-rectal fossa. From this fascia a leaflet is given off, which takes a direction transversely to the pelvis. It is designated the

Recto-vesical Fascia, or *vesical layer of the pelvic fascia.* The line of its attachment to the obturator fascia is the so-called *white line.* The course of the white line may be traced from the spine of the ischium to the posterior surface of the body of the pubis in an arc the convexity of which is downward. The lowest point of the arc is a little more than 5 cm., 2 inches, below the pectineal line. By some anatomists that portion of the fascia covering the obturator internus muscle below the white line only is designated the obturator fascia, that above being described as part of the pelvic fascia.

The recto-vesical fascia meets its fellow from the opposite side in a median raphe. Here it is perforated by the rectum and by the vagina, in the anterior wall of which is the lower part of the urethra. It may be traced into the walls of these canals. Webster has separately described the portion between the bladder and the vagina, that between the vagina and the rectum, and that posterior to the rectum as the *vesico-vaginal*, the *recto-vaginal*, and the *rectal* layers respectively. The following is taken also from the same author: "Further, the arrangement of the visceral [recto-vesical] fascia in the anterior part of the pelvis is of considerable importance. Here the visceral [recto-vesical] layer arising from the back of the lower part of the pubis on each side of the middle line above the point of origin of the anterior fibres of the *levatores ani* as well as the attachment of the parietal [obturator] fascia passes backward as two strong bands above them and on each side of the urethra, to become blended with the anterior surface of the bladder. These are the *anterior*

FIG. 15.

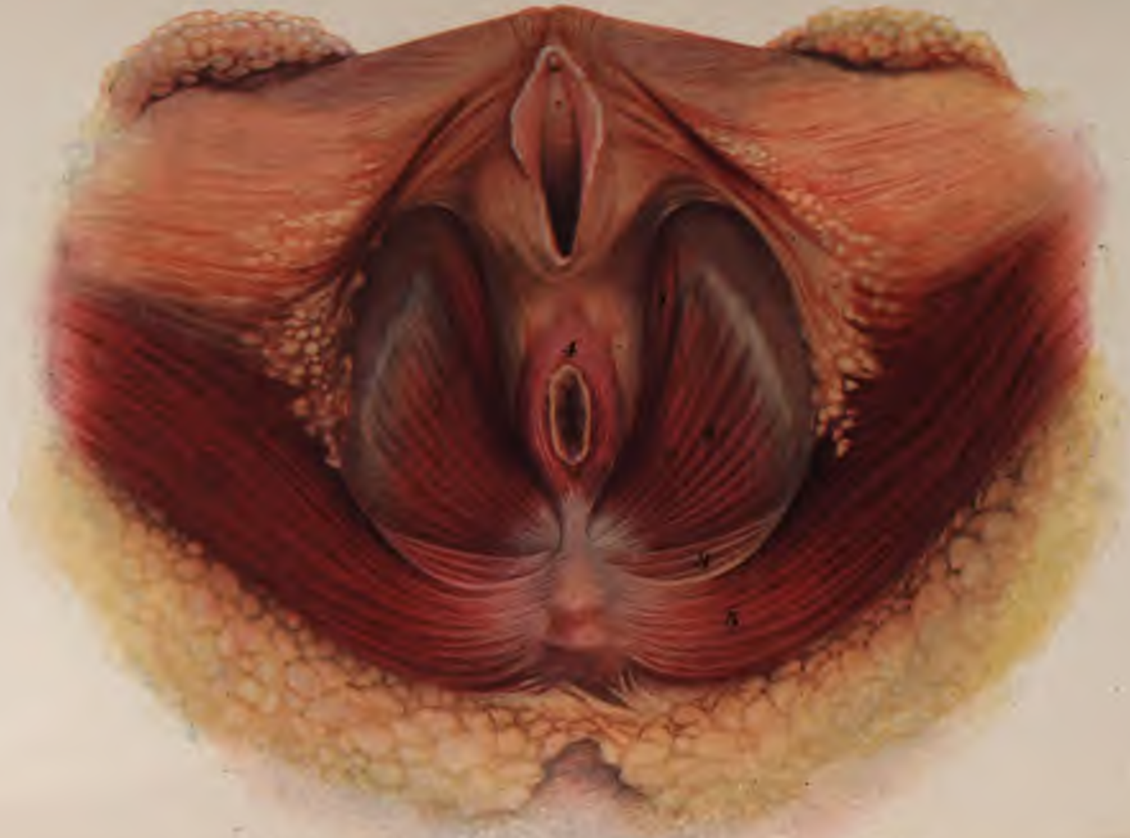


Sagittal section of the pelvis. (BROWNING.)

S. Symphysis. P. Perineal ledge. 1. Superficial layer of the superficial fascia. 2. Deep layer of the superficial fascia (Colles' fascia in the male). 3. Anterior layer of the triangular ligament. 4. Posterior layer of the triangular ligament. 5. Recto-vesical fascia.

It is to be understood that these planes of fascia are perforated by the urethra, the vagina, and the rectum.

PLATE VI.



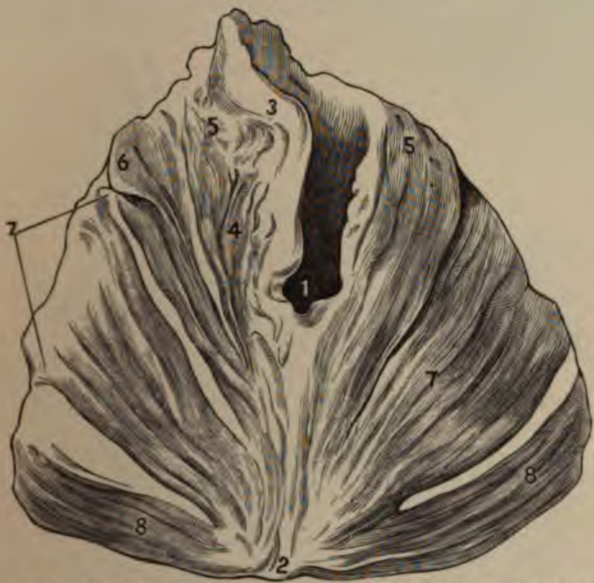
LEVATORES ANI, VIEWED FROM BELOW. FROM A DISSECTION.

1. Fibres arising from os pubis; 2. Fibres arising from the white line; 3. Fibres

true ligaments of the bladder. Between them is a space filled with loose connective tissue and fat, continuous below with the retro-pubic fat and above with the suprapubic or retro-peritoneal fat."

Just external to the anterior true ligaments, as above described, portions of the recto-vesical fascia are reflected upon the bladder as its *lateral true ligaments.*

FIG. 16.



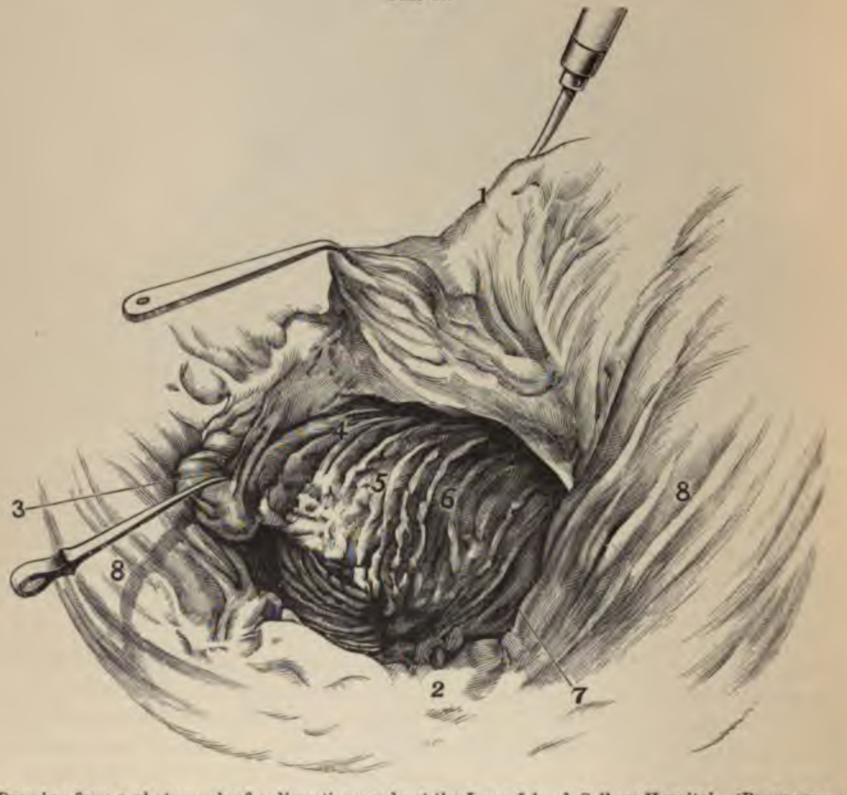
Drawing from a cast of a dissection made at the Long Island College Hospital. (BROWNING.)

1. Rectum. 2. Coccyx. 3. Labium minus. 4. Sphincter ani externus. 5. Fibres of the levator ani arising from the os pubis. 6. Fibres arising from the triangular ligament. 7. Fibres arising from the "white line." 8. Fibres arising from the spine of the ischium.

The Superior or Posterior Layer of the Triangular Ligament. From the obturator fascia along its attachment to the ramus of the ischium and to the descending ramus of the pubes a fascia is derived which meets its fellow in the median line. It is superficial to the levator ani muscle and blends with its sheath. In the middle line it is continued into the sheath of the vagina and unites with the recto-vesical fascia. By union with the corresponding structure of the opposite side a triangular sheet is formed which is perforated by the vagina and the urethra. Its apex is at the subpubic arch and its base joins the anterior or inferior layer of the triangular ligament at the perineal ledge. To this structure, weak in character, has been given the name *superior or posterior layer of the triangular ligament.*

The Levator Ani Muscle. Underlying (*i. e.*, superficial to) the recto-vesical fascia is the *levator ani* muscle. Respecting its origin anatomists are practically agreed, but the direction of its fibres and their insertion has been variously described. It arises from the intrapelvic surface of the body of the os pubis and from the posterior layer of the triangular ligament, from the spine of the ischium and from the whole length of the white line. The fibres arising from the pubis, those from the white line, and those from the ischium are sufficiently distinct as to their arrangement and as to their insertion to entitle them to separate description if not to entitle them to be considered separate muscles. The area of pubic origin is located about 12 mm., ½ inch, from the symphysis and 3.5 cm., 1⅛ inch, below the upper border of the bone. The fibres arising here are joined by those from the posterior layer of the triangular ligament. This latter structure blends with the obturator fascia along the descending pubic ramus. It will thus be seen that the origin of the pubic portion of the levator is more extensive than usually described and that its plane is superficial to and intersects that of the portion arising from the white line. The fibres, arising as above described, soon gather to form a band, about 12 mm., ½ inch, wide and 3 mm., ⅛ inch, thick, and distinctly separable from the rest of the muscle. It takes a course nearly horizontally backward toward the anus. At its insertion it is bilaminar. The superficial fibres are continued into the sphincter ani externus, of which they become a part. Of the deeper fibres a few turn forward into the perineal body. By far the greater number take a backward course.

FIG. 17.

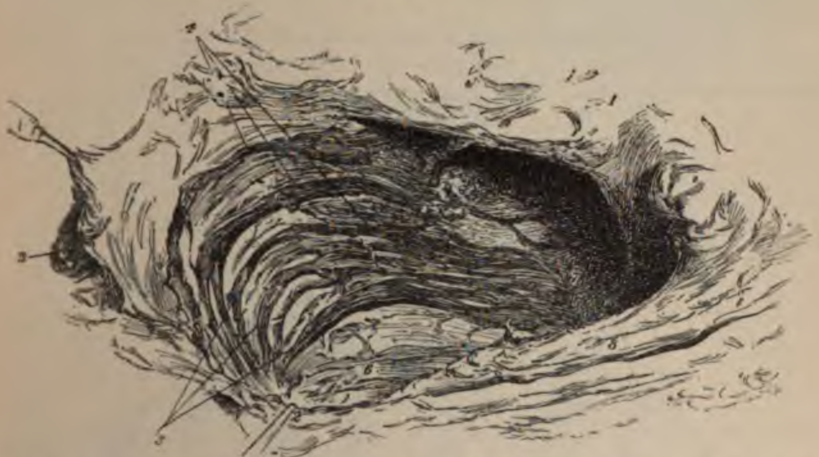


Drawing from a photograph of a dissection made at the Long Island College Hospital. (BROWNING.)

1. Symphysis. 2. Coccyx. 3. Anus. 4. Superficial fibres from the pubic origin of the levator ani. 5. Deeper fibres from the pubic origin. 6. Fibres from the "white line." 7. Fibres from the spine of the ischium. 8. Gluteus maximus muscle.

Posterior to the rectum they come in close contact with their fellows from the opposite side, but do not join them, as is sometimes stated, either with or without the intervention of tendon. Most can be traced to the coccyx, though some fall short thereof, ending in the sheath of the muscle. As the pubic band sweeps by the vagina it is 5 mm., ¼ inch, distant therefrom. A few stray fibres from its lowermost origin, by no means constant, cross above the band and terminate in the vaginal wall. They correspond to the levator prostatæ in the male.

FIG. 18.



Drawing from a photograph of a dissection made at the Long Island College Hospital; individual fibres of the levator isolated. (BROWNING.)

1. Symphysis pubis. 2. Coccyx. 3. Anus. 4. Deep fibres from pubic origin. 5. Fibres from fascial origin. 6. Fibres from ischial spine. 7. White line. 8. Gluteus maximus muscle.

The fibres from the ischium arise from the inner aspect of the spine contiguous to and just in front of the coccygeus muscle. They form a spindle-shaped bundle, thicker, somewhat more superficial than, and distinctly separable from the fibres of fascial origin. They may also be distinguished by their darker color. The course of the bundle is nearly transverse, and it is for the most part inserted into the fourth coccygeal segment. A few superficial fibres turn forward upon the recto-coccygeal raphe.

The portion of the levator intermediate between those already described is thin and membranous. It consists of a number of fascicles which arise from a fascia weakly attached to the white line. Even in well-developed women the fascicles exhibit fascial intervals. In the aged and emaciated they undergo a marked degree of atrophy and degeneration. Their direction is downward, backward, and inward with varying obliquity toward the rectum and the recto-coccygeal raphe. The anterior are the most oblique and the posterior are nearly transverse. As they approach the rectum and the raphe they turn backward and course in a direction nearly parallel with the median line; most of them reach the coccyx; some become aponeurotic before doing so.[1]

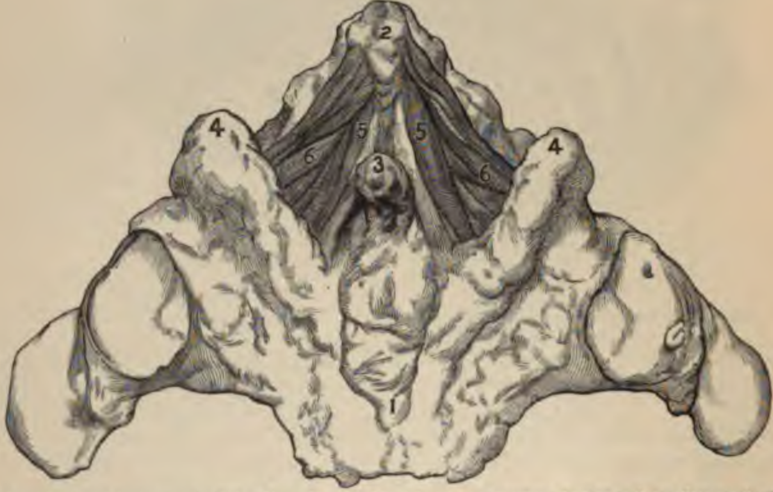
---

[1] The late Prof. Browning regarded the levator ani as a rudimentary muscle.

The levator ani muscle is lined by a thin fascia which adheres closely to it. It is known as the *anal* fascia. On the other hand, it can be readily dissected from the recto-vesical fascia. When thus dissected a delicate fascia may be demonstrated upon the upper surface of the muscle. This with the anal fascia constitutes its sheath. In the median line, extending from the rectum to the coccyx, the sheath of the levator ani muscle blends with the recto-vesical fascia forming the recto-coccygeal raphe. At the perineal body also and at the sides of the vagina and of the rectum these structures blend. This has led some authors to erroneously describe the levator as inserted into the walls of the rectum and of the vagina.

The recto-vesical fascia constitutes a support for the pelvic contents. By the contraction of the levatores ani this support is raised and the pelvic viscera elevated. The post-vaginal structures are also drawn forward. A very noticeable result of traction upon the pubic band is to evert the anus.

FIG. 19.



Drawing from a photograph of the dissection of the pelvis of a young primipara just after parturition. The levator ani cleaned and intrapelvic pressure removed. (BROWNING.)

1. Symphysis. 2. Coccyx. 3. Anus. 4. Tuberosity of the ischium. 5. Fibres from pubic origin. 6. Fibres from "white line." 7. Fibres from the spine of the ischium.

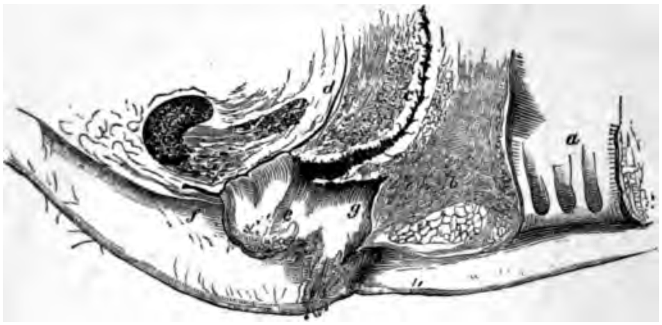
Those who have conducted investigations upon the lower animals will have observed the proportionately greater development of the levator ani in those possessed of a tail, and that its function in such animals is almost entirely to act upon that structure.

The triangular interval between the posterior border of the levator ani muscles and the anterior border of the pyriformis is filled in by the coccygeus. This is a thin muscular sheet. It arises from the spine of the ischium, and, spreading out fan-shaped, is inserted into the side of the coccyx and of the sacrum adjoining.

Savage, in his description of the pelvic floor, gives to the pubic portion of the levator the name "pubo-coccygeus;" to the rest of the muscle the name "obturato-coccygeus," and to the coccygeus the name "ischio-coccygeus."

The Perineal Body. It is unfortunate that the term "perineum," when treating of the female, is used somewhat ambiguously. By anatomists it is applied without distinction of sex to the whole perineal area. By obstetricians and gynecologists it is, as a rule, applied only to that span of tissue intervening between the anus and the posterior commissure of the vulva. This source of confusion is not cleared up by designating this latter area "the perineum *proper*." What obstetricians call the perineum or perineum proper corresponds to the central tendinous point in the male.

FIG. 20.



The external genitals, as seen in mesial section. (HENLE.)

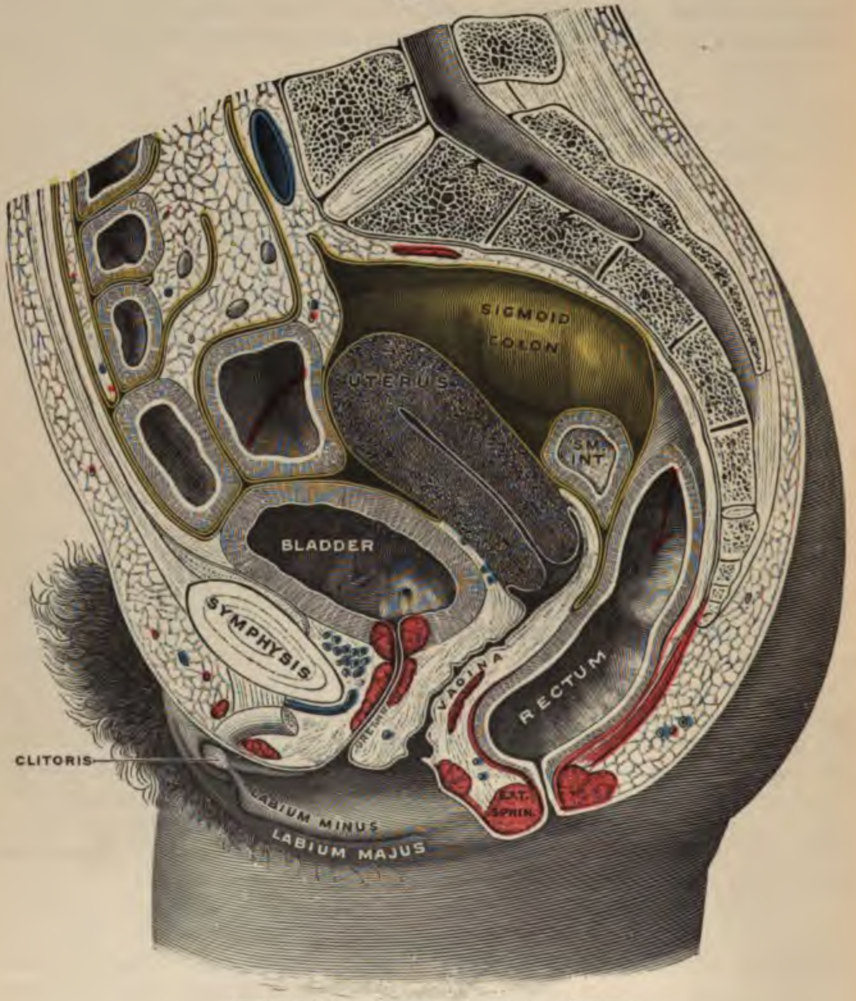
a. Anus. *b.* Perineal body. *c.* Vagina. *d.* Urethra. *e.* Labium minus. *f.* Clitoris. *g.* Fossa navicularis, in front of which is the hymen.

It has already been shown that underlying the skin and the superficial fascia of this limited space several muscles intermingle their fibres. They are the sphincter ani externus, the constrictor vaginæ, and the tranversus perinei. By the union of the deep layer of the superficial fascia and the deep fascia of the perineum (anterior layer of the triangular ligament) a strong resisting band (the perineal ledge) is formed. This stretches between the tuberosities of the ischia, and in crossing meets the anterior limit of the external sphincter ani muscle. These structures meeting at the central point of the perineum, together with the areolar, elastic and involuntary muscular tissue disposed between and about them, form the larger and by far the most important part of what has been designated the *perineal body*.

It has already been stated that the rectum and the vagina, though opening at a distance from each other of 2.5 cm., 1 inch, come in contact at about 4 cm., 1½ inch, from their orifices. The *perineal body* is the aggregation of tissues included between these canals below their contact. It is usually described as triangular in outline upon sagittal section and pyramidal in form. When the rectum and the vagina are flaccid it is gourd-shaped rather than pyramidal. The tissues forming its expanded portion or base have been already described. So much of the body as lies above the pelvic fascia does not differ essentially in structural character from the connective tissue disposed elsewhere among the intrapelvic viscera.

The Bladder. The *bladder* is a hollow muscular organ lined with mucous membrane. It is more or less intimately connected to surrounding parts by dense fibrous or by loose areolar tissue. In structure and function it does not differ in the sexes. It will be necessary in a work of the scope of this to call attention only to certain peculiarities of form in the female bladder and to such relations as are of interest to the obstetrician. Its capacity is stated to be somewhat less than that of the male bladder, though, under some circumstances, it is more distensible. It is interposed between the symphysis pubis in front and the uterus and the vagina behind. The *neck* surrounds the urethral opening. It, as a rule, is the most dependent portion of the organ when the erect position

Fig. 21.

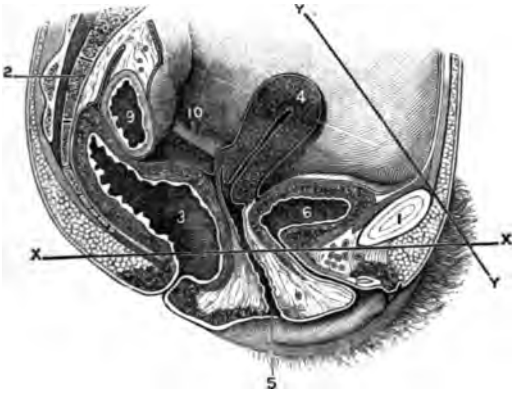


Sagittal section of the female pelvis. (TESTUT.)

of the body is assumed. The circular muscular fibres are here augmented somewhat, and the mucous membrane presents a puckered appearance. To the reinforced circular fibres has been given the name *sphincter vesicæ.* This name, however, is misleading, since there exists here no true sphincter. The term "neck" is also unfortunate in the description of the bladder, for the reason that the entrance of the urethra is abrupt and not gradual. The uvula is less distinct and the trigone is smaller than in the male bladder. The triangle, at the angles of which are located the urethral opening and the ureteric orifices, is more nearly equilateral, each leg measuring about 3.5 cm., 1½ inch.

At a variable distance above the pubic bone the peritoneum is reflected from the anterior abdominal wall to the summit of the bladder. The space under this membrane and between the anterior bladder-wall and the pubes is known as the *cavity of Retzius.* It is occupied by a mass of loose areolar tissue which allows considerable mobility to the viscus.

FIG. 22.



X. Plane of pelvic outlet. Y. Plane of pelvic inlet. 1. Symphysis. 2. Sacrum. 3. Rectum. 4. Uterus. 5. Vagina. 6. Bladder. 9. Sigmoid flexure of the colon. 10. Utero-sacral ligament. (TESTUT.)

Posteriorly the bladder is connected with the upper part of the vagina and with the cervix uteri by a firmer connective tissue. From the summit of the bladder the peritoneum is reflected upon the uterus at about the level of the os internum, forming the *vesico-uterine pouch.*

When empty the bladder sinks below the pelvic brim and the fundus of the uterus falls forward upon it. The vesico-uterine pouch is then collapsed and the intestines rest upon the posterior uterine wall. When distended the bladder rises into the abdominal cavity. It carries the uterus upward and pushes it backward, and coils of intestine may fall into the vesico-uterine pouch.

The distended bladder of the adult female is ovoid, the long axis being transverse. That of the child and that of the aged assume more nearly the masculine type. When empty the bladder sinks beneath the pelvic brim and the uterus drops forward upon it. Upon sagittal section the long axis of the collapsed bladder would form nearly a right angle with that of the vagina.

The Urethra and the Urethro-vaginal Septum. The *urethra* of the female is about 3.5 cm., 1⅓ inch, in length. Its axis is nearly parallel with the plane of the pelvic brim. Its lower three-fourths is embedded in the anterior vaginal wall. Its upper fourth is separated therefrom by a mass of cellular tissue. The average diameter of the canal is 5 mm., ¼ inch, though it is very dilatable. Its walls are muscular and lined with mucous membrane. The mucous membrane is thrown into longitudinal folds by the presence of elastic fibres in the submucosa. The muscular wall consists of two distinct strata of smooth fibres. Those of the internal stratum are longitudinal in direction, continuous with the longitudinally disposed fibres of the bladder. The external stratum is continuous with the sphincter vesicæ. In the upper fourth of the urethra the external fibres encircle the canal. In its lower three-fourths they may be demonstrated anteriorly to it only, being continuous posteriorly with the circular fibres of the vagina. The striated fibres from the deep transversus perinei muscles which meet in front of the urethra are sometimes described as the *compressor urethræ or Guthrie's muscle.* Some investigators claim to have demonstrated the presence of voluntary fibres encircling the upper part of the canal, which they contend act as a voluntary sphincter. The arrangement of the sphincter vaginæ of Luschka, whereby the urethra is compressed against the urethro-vaginal septum has already been alluded to.

The *urethro-vaginal septum* may be nearly or quite 1.5 cm., ½ inch, in thickness in the lower three-fourths. Above, the canals are more widely separated by the interposition of cellular tissue. An idea of the relative position of the parts, as well as of the thickness of the septum, may be gained from the following statement: If a line be drawn from the middle of the posterior surface of the symphysis pubis to the cervix uteri, its length would be about 5 cm., 2 inches, and the vesical opening of the urethra would be located at about the union of the anterior and middle thirds. Quain states that the female urethra corresponds to the prostatic portion in the male. There seems, however, to be no ground for making so definite a statement.

Throughout, the mucous membrane of the urethra presents the orifices of tubular glands. Two tubules, much larger than the rest, open upon the floor of the urethra near the meatus. Their mouths are not readily discernible, except under pathological conditions. They are known as Skene's glands.

Development of the Sexual Organs. At the beginning of the seventh week the embryonic structures from which the reproductive organs are to be developed present the same appearance in both sexes. The intestinal and genito-urinary canals discharge into a common chamber or *cloaca.* Just within the cloaca, anteriorly, is an elevation of tissue representing the future external organs of generation. The canal leading to the bladder is comparatively large and is known as the *uro-genital sinus.* In the lumbar region are two glandular structures, one upon each side. They are the *Wolffian bodies.* From their lower extremities the *Wolffian ducts* lead inward and downward to the uro-genital sinus. Upon each side another tubular structure may be observed. Above, it lies upon the external surface of the Wolffian body. At the lower extremity of the Wolffian body it crosses the Wolffian duct, from without inward, and, turning downward, runs along its inner side to reach the uro-genital sinus. This is the *duct of Müller.* Medially the lower portion of the ducts of Müller are in contact. Subsequently the partition between them disappears, and the single tube, thus resulting, becomes the "foundation of the vagina and uterus in the female, and the prostatic vesicle or uterus masculinus in the male; the upper or forepart of the Müllerian duct disappears in the male; in the female it forms the oviduct" (Quain). Arrest of development will explain the congenital malformations of double uterus and double vagina.

FIG. 23.

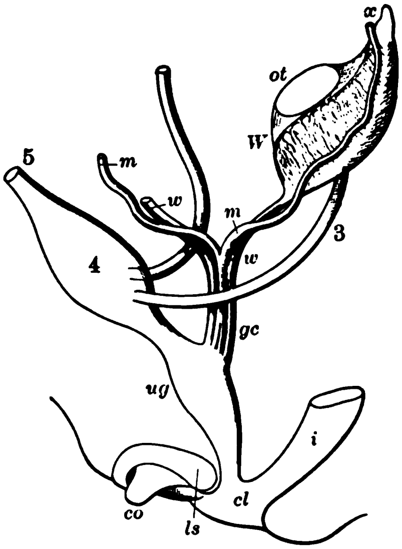


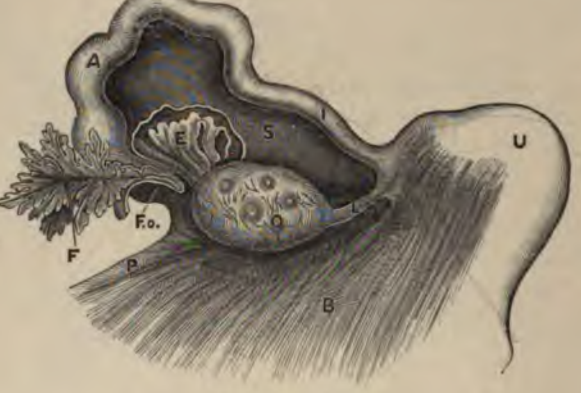
Diagram of the primitive uro-genital organs in the embryo previous to sexual distinction. The parts are shown chiefly in profile, but the Müllerian and Wolffian ducts are seen from the front. 3. Ureter. 4. Urinary bladder. 5. Urachus. *ot.* The mass of blastema from which ovary or testicle is afterward formed. *W.* Left Wolffian body. *x.* Part at the apex from which the coni vasculosi are afterward developed. *w, w.* Right and left Wolffian ducts. *m, m.* Right and left Müllerian ducts uniting together and with the Wolffian ducts in *gc*, the genital cord. *ug.* Sinus urogenitalis. *i.* Lower part of the intestine. *cl.* Common opening of the intestine and uro-genital sinus. *co.* Elevation which becomes clitoris or penis. *ls.* Ridge from which the labia majora or scrotum are formed. (GRAY.)

The reproductive gland (testicle or ovary) is developed from the Wolffian body. The Wolffian body is held to the posterior abdominal wall by a reflection of peritoneum from which a fold passes downward to the groin. After the atrophy of the parent structure its peritoneal investment forms the mesovarium or mesorchium, as the case may be, and the descending fold (*plica gubernatrix*) becomes the gubernaculum testes in the male and the round and ovarian ligaments in the female. The Wolffian duct, which in the male develops into the vas deferens and the epididymis, disappears, for the most part, in the female. A remnant, however, corresponding to the globus major, persists as a rudimentary structure, and is described under the name of the *parovarium* or *epoöphoron*.

As is the case with the testis, so the ovary migrates. Its descent is arrested, however, by the plica gubernatrix becoming attached to the Müllerian duct. This accounts for the permanent location of the ovaries and for the attachment of the ovarian and the round ligaments to the uterus.

The Fallopian Tubes. The *Fallopian tubes*, for the reason that they conduct the discharged ova to the uterine cavity, have been denominated the *oviducts*. They are within the folds of the broad ligaments and occupy their superior borders, reaching from the cornua of the uterus nearly to the lateral pelvic walls. They vary in length from 7.5 cm. to 12.5 cm., 3 to 5 inches. As a rule, the right tube is somewhat the longer of the two. In their development the Fallopian tubes may be considered as finally penetrating the broad ligaments, so that they open into the peritoneal cavity. The broad ligaments surround them much as the peritoneum does the small intestine. Since to the tube is applied the technical name "salpinx," the designation *mesosalpinx* is given to that portion of the broad ligament included between the tube above and the ovary and the utero-ovarian ligament below. The appearance of the distal end of each tube is that of a ragged tear through the broad ligament above and just external to the ovary. From this point to the lateral pelvic wall the superior border of the broad ligament is firm and reinforced by fibrous tissue. It presents a sharply concave outline. It forms the *ligamentum infundibulo-pelvicum* or *ligamentum suspensorium ovarii.*

FIG. 24.



Fallopian tubes.

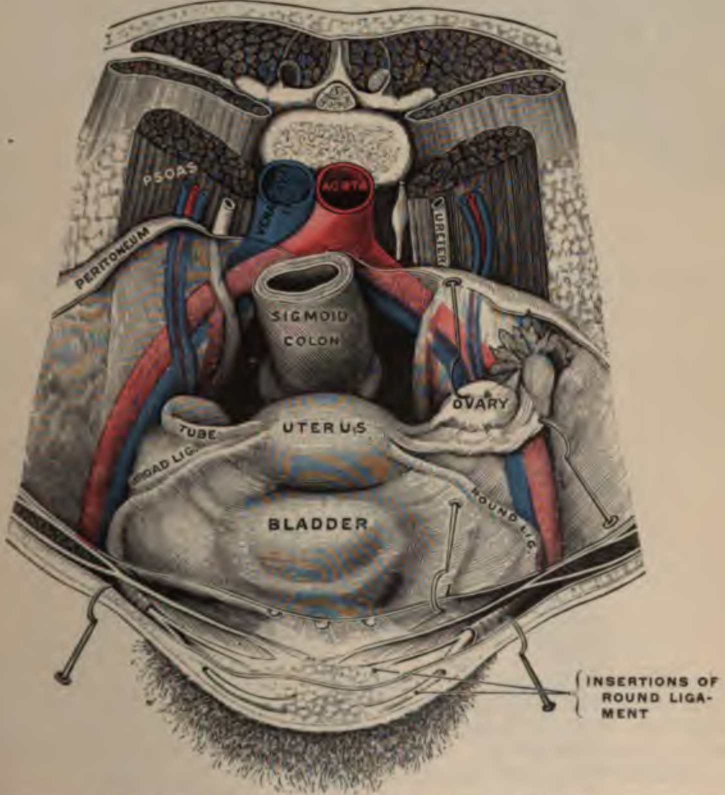
U. Uterus. I. Isthmus. A. Ampulla. F. Fimbriæ. F.o. Fimbria ovarica. S. Mesosalpinx. O. Ovary. L. Ligamentum ovaricæ. P. Ligamentum infundibulo-pelvicum. E. Parovarium. (HENLE.)

It is quite evident that the position of the broad ligaments, and consequently that of the ovaries and of the tubes, will vary with that of the uterus. The latter organ is not firmly fixed in the pelvic cavity and its fundus is especially movable. Concerning the usual position of the uterus there has been much controversy. From the intimate connection of the cervix to the bladder, anteriorly, and of its proximity to the rectum, posteriorly, it will be understood that the direction of the long axis of the uterus will vary according to the contents of these viscera. When the bladder and the rectum are both empty, the fundus of the uterus will drop forward so that the long axis of the uterus will form nearly a right angle with that of the vagina, and the uterus will sink wholly beneath the plane of the pelvic brim. There may also exist in the organ a certain degree of anteflexion. The broad ligaments will now arch about the pelvic walls from before backward, and their uterine will be on a lower level than their pelvic attachments. When the bladder fills the fundus uteri is pushed upward and backward, and may rise above the plane of the pelvic brim. The long axis of the uterus becomes then more nearly vertical, and the broad ligaments with the uterus assume the position described as a transverse pelvic partition.

When the uterus is in its anteverted position the Fallopian tubes, springing from its cornua, curve about the pelvic brim, superiorly to the ovaries, and turn downward and backward around the distal extremities of these organs. The fimbriated extremities of the tubes are on a level with the lower border of the ovaries, posterior to them. The curves in the tubes are inherent in them, and are not due to their position against the pelvic walls, as may be proven by studying them when the uterus with its adnexa is removed from the body.

The Fallopian tubes are muscular structures and are lined by an extension of the mucous membrane from the uterus. At their distal extremities the mucous membrane meets the serous surface of the peritoneum. The muscular coat of each tube may be divided into an external and an internal layer. The fibres of the external layer are longitudinal and are continuous with the external stratum of the uterus. Those of the internal layer encircle the tube and are continuous with the internal stratum of the uterus. The circular fibres are greatly increased in number where the tube opens into the uterine cornu.

FIG. 25.

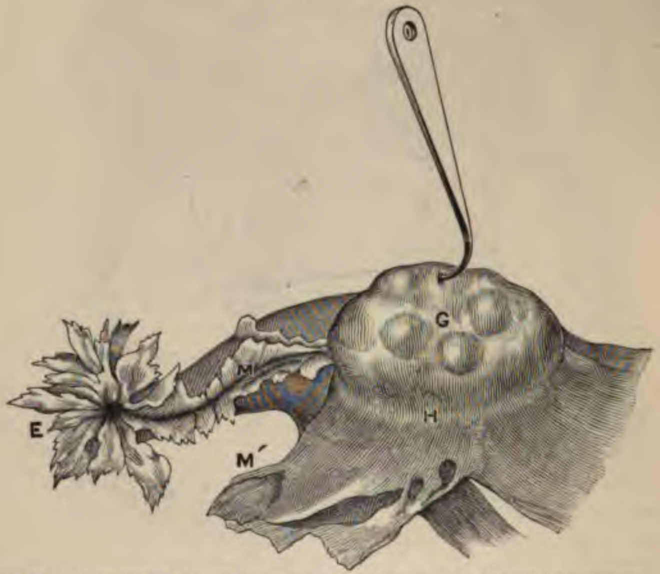


The pelvic viscera of woman, seen from above (the left ovary and tube have been drawn up into the left iliac fossa). (TESTUT.)

The oviduct differs so much in form, in diameter, in calibre, and in appearance in different parts of its length, as to have led to its division into four portions. These are the isthmus, the ampulla, the neck, and the fimbriated extremity. The isthmus extends from the uterus for about two-sixths of the whole length of the tube. Its diameter is about 3 mm.,

$\frac{1}{8}$ inch. Its calibre at the uterine opening is small, admitting but a very fine bristle, but it gradually enlarges toward the ampulla. It has a solid or cord-like feel. The ampulla occupies three-sixths of the length of the tube, and extends from the isthmus to the neck. It is the most tortuous portion, the curve of which has been already described. Its diameter increases from the isthmus to the neck, and may reach a maximum of 1 cm., or a little more than one-third inch. The diameter of its lumen is half that of the tube itself, thus rendering the ampulla less firm to the touch than is the isthmus. The distal sixth of the Fallopian tube displays a "funnel-shaped expansion surrounded by a fringe of peculiar fleshy processes, which recall in a striking manner the tentacles of a sea-anemone" (Coe). These ragged fringe-like processes are denominated *fimbriæ*, and they give to this portion of the tube the name *fimbriated extremity.* It is the "morsus diaboli" of the ancient anatomists. The *neck* of the Fallopian tube marks the union between the ampulla and the fimbriated extremity. Distally the canal of the tube terminates in the *ostium abdominale.* Quain cites authority for the statement that this orifice is physiologically closed during life, though dilatable to the extent of 4 mm., $\frac{3}{16}$ inch. The expanded mucous-lined portion of the tube distad to the ostium abdominale is designated the *infundibulum* or *pavilion.* The primary fimbriæ are four or five in number, but they send secondary offshoots from their edges, presenting a complex appearance. One of the primary fimbriæ, larger and less complex than the

FIG. 26.

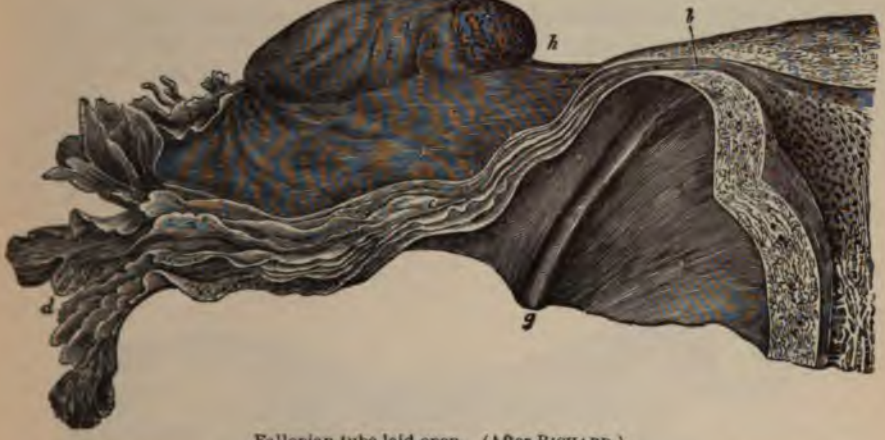


Left ovary turned up, showing the surface usually in contact with the broad ligament; shows also the fimbria ovarica and the fimbriated extremity of the Fallopian tube. (BROWNING.)

G. The ovary. H. Line of limitation between the ovary and the broad ligament. E. Fimbriated extremity of the Fallopian tube. M. Fimbria ovarica. The letter M′ lies above the infundibulo-pelvic ligament, which is cut at the pelvic end.

others, is attached to the outer extremity of the ovary. It is known as the *fimbria ovarica.*

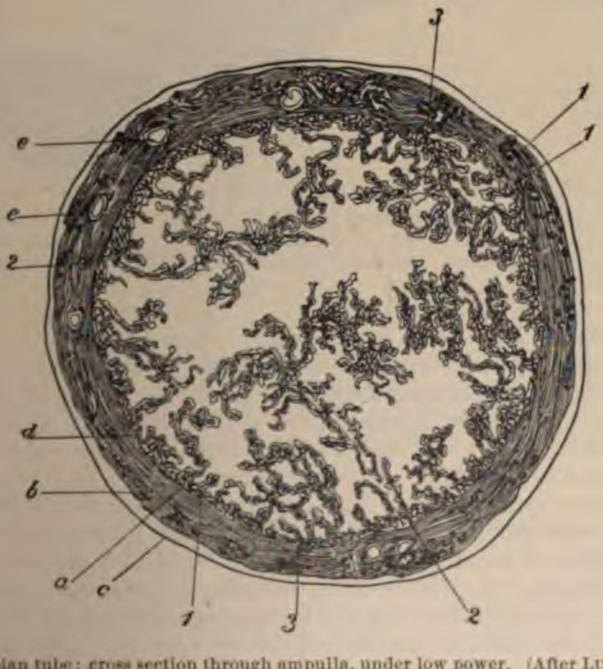
FIG. 27.



Fallopian tube laid open. (After RICHARD.)

a, b. Uterine portion of tube. *c, d.* Plicæ of mucous membrane. *e.* Tubo-ovarian ligaments and fringes. *f.* Ovary. *g.* Round ligament.

FIG. 28.

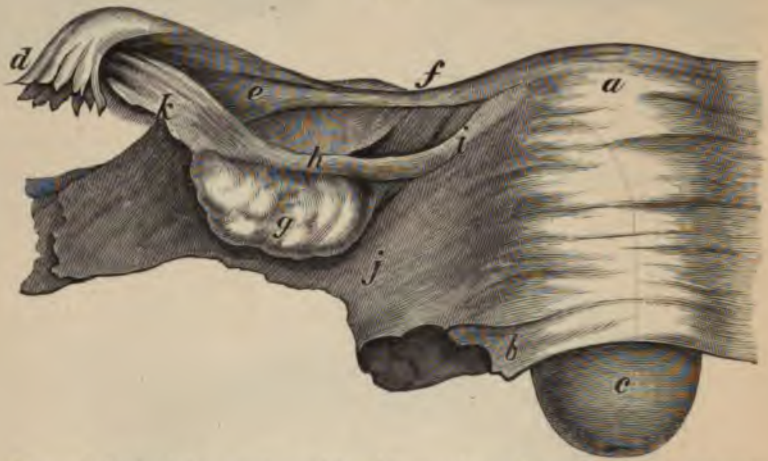


Fallopian tube; cross section through ampulla, under low power. (After LUSCHKA.)

a. Submucous layer. *b.* Muscular layer. *c.* Serous coat. *d.* Mucous membrane. *e, e.* Vessels. 1, 1. Small primary folds. 2, 2. Larger longitudinal and accessory folds. 3, 3. Small folds united forming canaliculi.

The mucous lining of the Fallopian tubes is not as closely adherent to the muscular structure as is that in the body of the uterus. However, it has no distinct submucosa. It is disposed in longitudinal folds, which are somewhat more complex in the ampulla than in the isthmus. This gives to the lumen of the tube on cross section a stellate appearance. The furrows are continued upon the fimbriæ, so that the fimbria ovarica presents a gutter leading from the ovary to the pavilion. The epithelium is of the columnar variety and ciliated throughout. The cilia possess remarkable activity and produce a current toward the uterus. The *hytadids* or *cysts of Morgagni* are little bodies sometimes found attached by pedicles to the fimbriæ or to the broad ligaments adjacent thereto. They are remnants of fœtal structures.

FIG. 29.



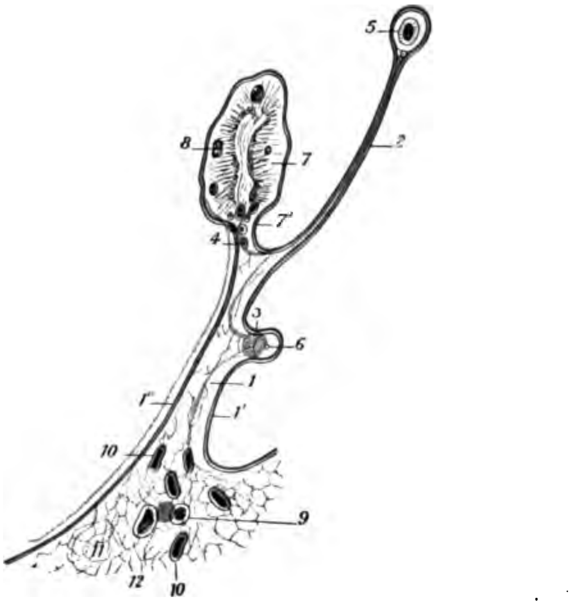
Uterus, Fallopian tubes, ovaries, and broad ligaments seen from behind. (BROWNING.)

a. Fundus of uterus. *b*. Attachment of utero-sacral ligament. *c*. Cervix. *d*. Fimbriated extremity of Fallopian tube. *e*. Ampulla of same. *f*. Isthmus of same. *g*. Ovary. *h*. Line of limitation between ovary and broad ligament. *i*. Ovarian ligament. *j*. Posterior surface of broad ligament. *k*. Fimbria ovarica.

The Ovaries. The *ovaries* are the reproductive glands of the female and are the analogues of the testicles in the male. Each is an almond-shaped body varying in weight and dimensions according to its functional activity. In the adult virgin it may be stated to be 4 cm., 1½ inch, in length, 2 cm., ¾ inch, in breadth, and 1 cm., ⅜ inch, in thickness. Its weight is 8.5 grammes (⅓ ounce). In the parous woman it is diminished in both weight and volume by about 30 per cent. The ovary may be described as having two surfaces, two borders, and two extremities. Sections, longitudinal and transverse, show it to be irregularly ovoid. One surface is the flatter, one border the straighter, and one extremity the narrower. In its migration from the lumbar region, where it is developed, the ovary is arrested and drawn between the folds of the broad ligament. It may also be considered as pushed into a pouch (the ***bursa ovarica***) formed in the posterior layer of the broad ligament. It is thus completely invested by peritoneum except along its straighter border. This border, thinner than the other, is designated the *hilum*. It is here that the vessels enter the gland and emerge from it. The ovary, thus invested, hangs in the peritoneal cavity from the posterior surface of the broad ligament. Its wider extremity is connected to the lateral pelvic wall by the ligamentum suspensorium ovarii; its narrower extremity has attached to it the ligament of the ovary.

If the fundus of the uterus be raised and the broad ligaments stretched out, the ovaries hang by their attached borders and their more convex surfaces are in contact with the ligaments. When, however, the uterus is in its usual anteverted position the ovaries are in a plane posterior to it. They lie upon the lateral pelvic walls, parallel to and 2.5 cm., 1 inch, or more below the plane of the inlet. Their narrower extremities point forward and inward. Moreover, they may turn upward so that the flattened surfaces come in contact with the broad ligaments and the free borders are superior to the hila. The Fallopian tube curves about the distal extremity of the corresponding ovary, and the fimbria ovarica is applied to the more convex border. The pavilion falls below the level of the ovary, but presents toward it.[1]

FIG. 30.



Sagittal section through the ovary and broad ligament.

1. Broad ligament. 1'. Anterior surface. 1''. Posterior surface. 2. Mesosalpinx. 5. Fallopian tube. 6 Round ligament. 7. Ovary. 7' Hilum of ovary with vessels entering the same. 8. Graafian follicle. 9. Uterine artery. 10. Uterine veins. 11. Cellular tissue at the base of the broad ligament. 12. Ureter. (TESTUT.)

Each ovary lies in a fossa bounded above by the external iliac artery and below by the ureter. The left may be in contact, internally, with the sigmoid flexure of the colon, and the right with a coil of small intestine.

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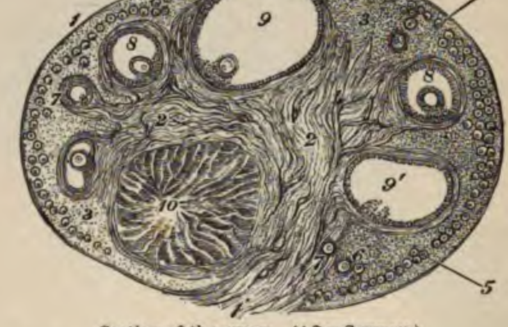
[1] The writer has noticed, while experimenting upon the cadaver, that forcible anteversion of the uterus causes the ovaries to turn, so that the surfaces, under other conditions in contact with the broad ligaments, are lifted and brought more directly into relation with the fimbriated expansions of the Fallopian tubes.

The peritoneal covering of the ovary is so far modified in character as to have led some histologists to class it with the mucous rather than with the serous membranes. It does not present the glistening appearance of peritoneum generally, and minute examination reveals that it is covered with epithelial rather than endothelial cells. The cells are of the columnar variety. They were supposed by Waldeyer to be the parent cells of the ova, whence the name "germinal epithelium," applied to them. After puberty the surface of the ovary is uneven, the unevenness being occasioned by the presence of unruptured Graafian follicles and of the scars of those which have ruptured and discharged their contents. This is especially true of the more convex surface. In old age the entire surface of the ovary becomes smooth.

FIG. 31.



Section of the ovary. (After SCHRON.)

1. Outer covering. 1′. Attached border. 2. Central stroma. 3. Peripheral stroma. 4. Bloodvessels. 5. Graafian follicles in their earliest stage. 6, 7, 8. More advanced follicles. 9. An almost mature follicle. 9′. Follicle from which the ovum has escaped. 10. Corpus luteum.

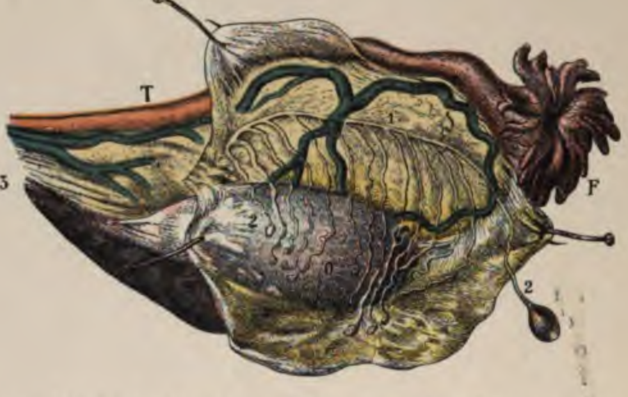
If a section be made through the gland its stroma will be found to consist of a core of loose connective tissue about which are arranged zones of connective tissue of varying density. The peripheral zone is dense, though thin. It is of a grayish color, which has obtained for it the name *tunica albuginea ovarii.* It is inseparable from the subjacent tissue, and is in no sense a distinct envelope. Underlying the tunica albuginea is the *zona parenchymatosa* or *cortical zone*. This zone may be subdivided into two layers. The superficial layer is the denser of the two. In it are embedded undeveloped Graafian follicles to the estimated number (for each ovary) of thirty thousand or more. The deeper layer of the cortical zone is less dense than the superficial. It is very vascular and is of a reddish color. It is separately designated the *zona vasculosa.*

Bands of fibrous tissue radiate from the hilum throughout the stroma of the ovary. Into the zona vasculosa unstriped muscular tissue may be traced from the broad ligament of the uterus.

The Graafian Follicle. The *Graafian follicle* or *ovisac* as it develops sinks into the zona vasculosa, but owing to its becoming more and more dis-

PLATE VII.

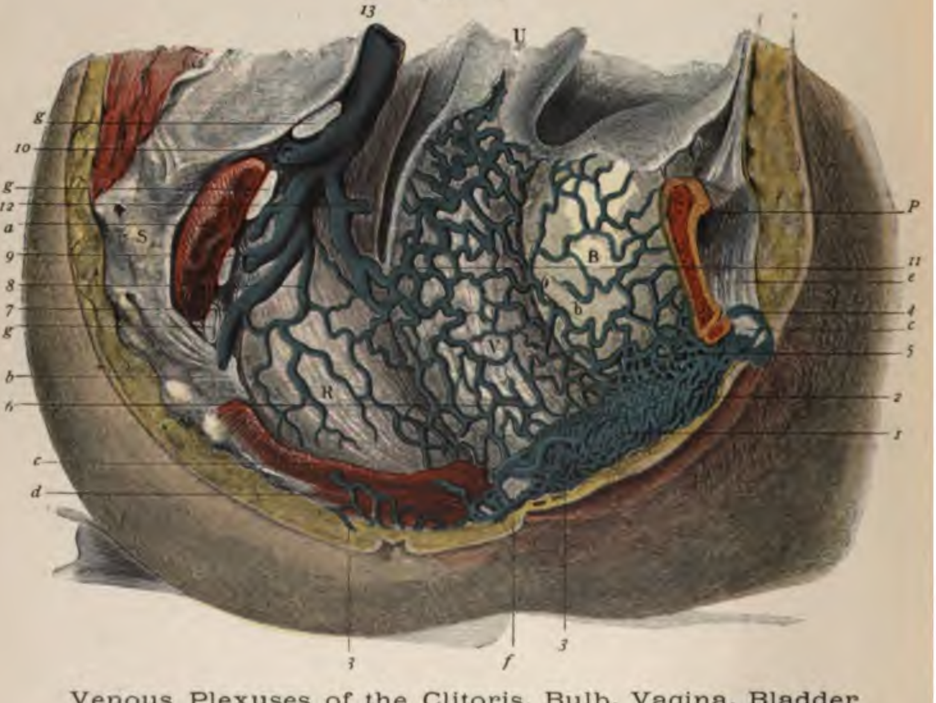
FIG. 1.



Meso-salpinx laid open, showing the Parovarium or Organ of Rösenmüller. (Savage.)

T, Fallopian Tube; F, fimbriated extremity of same; O, ovary; 1, remnant of Wolffian duct; 2, 2, remnants of the cæcal tubes of the Wolffian bodies; 3, ovarian ligament.

FIG. 2.



Venous Plexuses of the Clitoris, Bulb, Vagina, Bladder and Rectum, seen from the side. (Savage.)

B, bladder partly inflated and with (b) ureter cut; V, vagina; *P*, section of pubis; *c*, clitoris; U, uterus; R, rectum; S, sacrum; *1*, veins of the bulb; *2*, veins of pars intermedia; *3*, efferent veins to pubic vein; *4*, dorsal vein of clitoris; *5*, urethral plexus; *6*, vaginal plexus; *7* to *12*, branches uniting to form *13* the internal iliac vein; *a*, pyriformis muscle; *b*, great sciatic ligament; *c*, levator ani muscle; *d*, coccygeus muscle; *e*, suspensory ligament of clitoris; *f*, bulbo-vaginal gland; *g*, *g*, *g*, roots of sacral plexus.

tended with fluid, at maturity it approaches the surface of the ovary. Just prior to its rupture the ovisac presents the following characteristics. It is from 1 mm. to 5 mm., $\frac{1}{20}$ to $\frac{1}{6}$ inch, in diameter. It possesses a thin, fibrous envelope continuous, apparently, with the stroma of the ovary. This envelope sustains bloodvessels and supports a capillary network of the same. That part of the envelope projecting upon the surface of the ovary is most vascular, and it is here that the future rupture is destined to take place. This point is called the *stigma*. The investing membrane of the follicle is lined with several layers of columnar or cuboidal epithelial cells. This epithelial lining has been named the *membrana granulosa*. At some point, usually opposite the stigma, the cells of the membrana granulosa are greatly multiplied, constituting the *discus proligerus*. In the cells of the discus proligerus is embedded the *ovum*. On pricking the follicle a drop of clear serum exudes. At maturity, by the accumulation of this fluid and the consequent distention of the follicle, the investing membrane is ruptured at the stigma and the ovum is discharged upon the surface of the ovary.

The Corpus Luteum. After its rupture the Graafian follicle undergoes certain changes resulting in what may be considered a scar. This is formed by the infolding of the collapsed cell-wall, and it presents a fluted appearance. It is of a yellow color, whence its name, the *corpus luteum*. If the discharged ovum undergoes impregnation the development of the corpus luteum is of longer duration, and results in a larger cicatrix than when pregnancy does not occur.

The Parovarium. Lying between the folds of the mesosalpinx is the *parovarium*, *epoöphoron*, or *organ of Rosenmüller*. It is a fœtal relic and functionless, but analogous to the epididymis in the male. It consists of a number of convoluted tubules. These converge toward the ovary, to the hilum of which they are attached near its distal extremity. They spread out, fan-shaped, within the mesosalpinx and open into a duct which lies parallel with the Fallopian tube and nearer to it than to the ovary. The duct may be continued to the uterus, though its lumen becomes closed before it reaches that organ. It may present cystic enlargements or cyst-like bodies may be suspended from it by elongated pedicles.

The *paroöphoron* consists of several detached tubules lying internally to and below the epoöphoron (Quain). It corresponds to the organ of Giraldes in the male. (Plate VII., Fig. 1.)

The Ligaments of the Ovaries. The ligaments of the ovaries are dense fibrous bands about 4 cm., $1\frac{1}{2}$ inch, in length, and receiving muscular fibres from the external stratum of the uterus. They connect the ovaries and the uterus. They are attached to the narrower extremities of the ovaries and to the uterus just below and posterior to the attachments of the Fallopian tubes.

The Round Ligaments of the Uterus. The round ligaments of the uterus are fibrous bands or cords containing bloodvessels. They pass from the uterus, between the folds of the broad ligaments, to and through the inguinal canals. They are attached to the uterus just anterior to the attachments of the Fallopian tubes. Between the folds of the broad ligaments they each receive an investment of muscular tissue from the external stratum of the uterus.

In the usual anteverted position of the uterus, the round ligaments curve outward, upward, and forward, in front of the ovaries, to reach the sides of the pelvis. Here they cross the external iliac arteries. In this part of their course they pull forward the anterior layers of the broad ligaments, thus appearing to be invested by peritoneum. Leaving the broad ligaments they curve forward and inward to the internal abdominal rings, through which they enter the inguinal canals. At the internal abdominal rings they have the deep epigastric arteries to their outer sides. Traversing the inguinal canals they emerge from the external abdominal rings and break up into strands and are lost in the areolar tissue of the mons pubis and of the labia majora.

Though the round ligaments may be well defined throughout their entire length, they are, as a rule, difficult of demonstration in the lower parts of the inguinal canals, where they frequently consist of fascial expansions only.

In the infant the round ligament is invested throughout with peritoneum. This forms a tubular sheath about it, extending well into the inguinal canal. It corresponds with the processus vaginalis in the male, and is known as the *canal of Nuck*. As a rule, it is obliterated in the adult below the internal ring. However, it not only may persist, but may extend beyond the external ring, and into the labium majus.

The entire length of the round ligament is from 10 cm. to 13 cm., 4 to 5 inches. Its diameter near the uterus is about 4 mm., $\frac{3}{16}$ inch, and for the rest of its length a little less.

The Connective Tissue of the Pelvis. The spaces between the intrapelvic structures which have been described are filled in with connective tissue. This serves to unite and support the various organs and to sustain the vessels which supply them. It is dense and firm at the vesico-vaginal and at the recto-vaginal septum. Between the broad ligaments and beneath the utero-sacral bands it is reinforced by muscular tissue, as has already been described. In other situations, as between the pubic bones and the bladder, about the cervix uteri, between the rectum and the sacrum, and at the bases of the broad ligaments, it is loose and areolar in character.

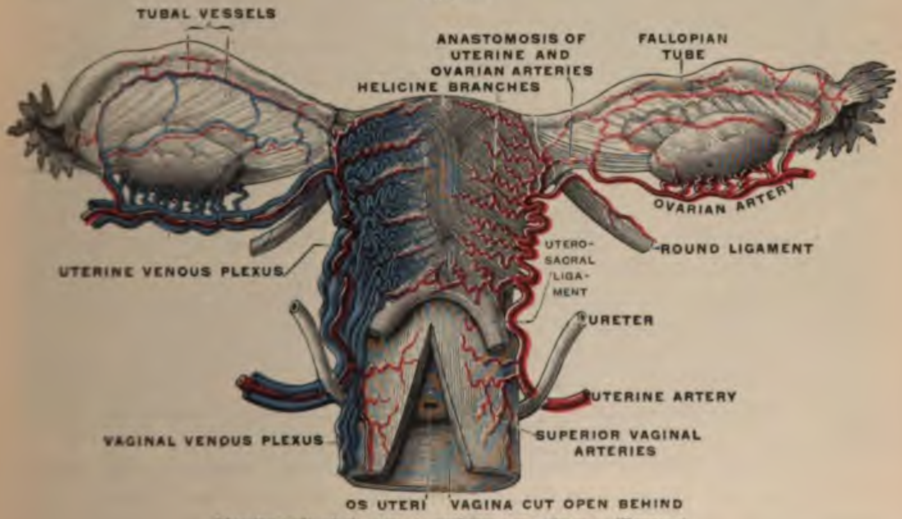
Blood- and Nerve-supply of the Pelvic Floor. With the exception of the ovarian arteries all vessels supplying blood to the pelvic structures are branches of the internal iliac arteries. The anterior trunk of the internal iliac artery on each side lies upon the pyriformis muscle. At the lower border of this muscle it divides into the sciatic and internal pudic arteries. Both of these arteries escape from the pelvis through the greater sciatic foramen below the pyriformis. The internal pudic artery, winding about the ischiatic spine, returns to the pelvis through the lesser sciatic foramen and supplies the genitalia.

The arteries and nerves supplying the genitalia and the pelvic floor in the female correspond with those distributed to analogous structures in the male. Their distribution has already been sufficiently discussed. Attention should be called, however, to the statement of Ranney, that the superficial vessels and nerves perforate the deep layer of the superficial fascia in the female, though not in the male. The fact should be mentioned, also, that the superficial artery is larger than its analogue in the male, and that it is sometimes called the *vulvar* artery. In this same connection it should be borne in mind that the anterior layer of the triangular ligament is perforated by the vessels which correspond with the dorsal arteries and vein of the penis, and with the arteries to the corpora cavernosa and to the bulb in the male.

The vascular and nervous supply of the bladder and of the rectum is practically identical in both sexes.

The Vessels and Nerves of the Vagina. The vagina gets its principal blood-supply from the vaginal arteries. These are analogous to the inferior vesical in the male. They may arise directly from the parent trunks or from the uterine arteries. Reaching the sides of the vagina they anastomose with the pudic arteries near the ostium, and with the uterine arteries near the cervix uteri. The blood is returned by veins which accompany the arteries. First, however, the veins form rich plexuses in the vaginal walls both internally and externally to the muscular coat. (Plate VII., Fig. 2.) The veins are devoid of valves and communicate freely with the pudendal, vesical, and hemorrhoidal plexuses, and with the plexuses between the folds of the broad ligament. The plexus external to the muscular coat consists of large vessels. These veins are surrounded by unstriped muscular fibres. Thus is formed a pseudo-erectile tissue.

FIG. 32.



Bloodvessels of the uterus and its appendages. (TESTUT.)

Along the veins of the vagina, and accompanying them, are lymphatic canals and spaces. Those of the lower third of the vagina communicate with the lymphatics of the vulva, and are drained by the inguinal glands. Those of the upper two-thirds join the lymphatics of the cervix and empty into a chain of glands which accompany the internal iliac arteries.

The nerve-supply of the vagina is derived, in the main, from the inferior hypogastric plexuses. Branches of the internal pudic nerve are distributed to its lower part.

The Vessels of the Uterus. The uterine artery, upon each side, is given off from the anterior trunk of the internal iliac either above the vaginal or in common with it. It enters the base of the broad ligament and descends between the folds to the roof of the vaginal fornix. After supplying the cervix it takes an upward turn and reaches the side of the uterus at about the level of the os internum. Proceeding upward it anastomoses freely at the fundus with the ovarian artery. Throughout its course along the body of the uterus it gives off numerous branches which, anastomosing with corresponding branches from the opposite side, encircle the organ. The parent trunks and their branches, because very tortuous in their courses, are spoken of as "the curling arteries of the uterus." One branch, larger than the others, at the level of the isthmus, is known as the *circular* artery. It may sometimes be found below the level of the isthmus.

The fundus of the uterus is supplied by terminal branches of the ovarian arteries.

The arteries of the uterus pierce its muscular walls and terminate in capillaries within the mucous membrane.

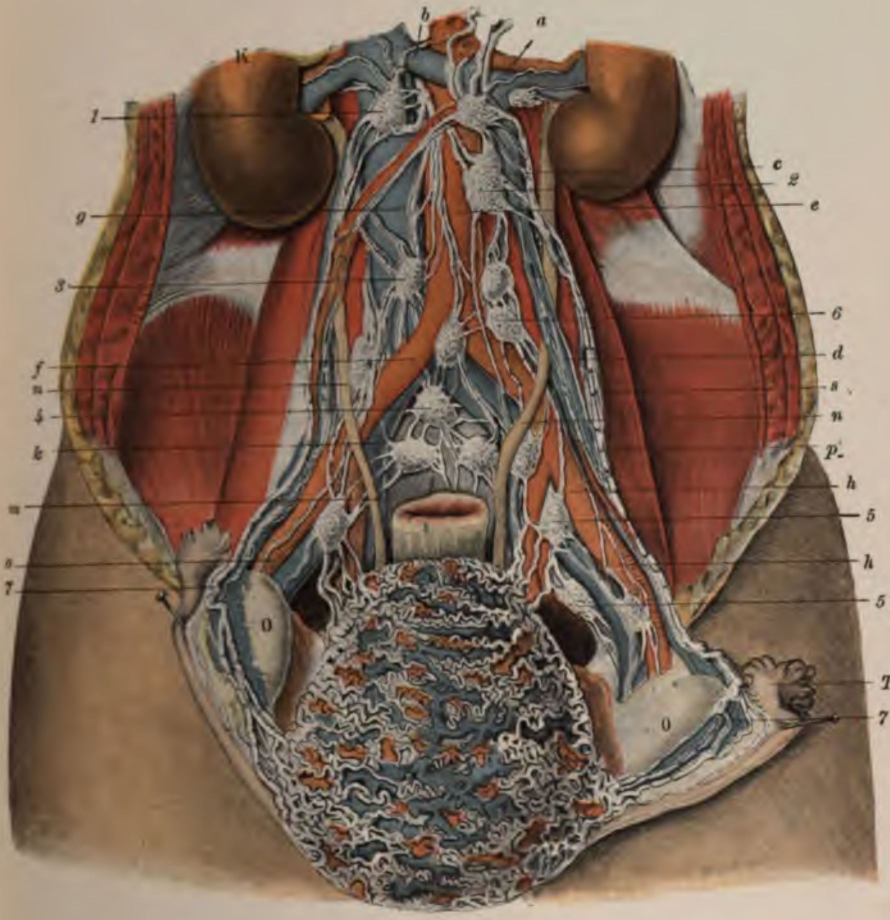
The veins are large and abundant in the middle muscular stratum. Their coats being intimately united to surrounding tissues render them always patulous. Rouget describes a direct communication between them and the arteries without capillary intervention. This, if true, would constitute the uterus an erectile organ. Under the peritoneal covering of the uterus the veins form an intricate plexus which communicates freely with that in the vaginal walls and with that between the folds of each broad ligament. The plexuses thus formed at the sides of the fornix have been named the *utero-vaginal plexuses.* They are of especial interest because traversed by the ureters, which, entering the pelvis, cross the iliac vessels from without inward and pass under the uterine arteries. The ureters here are about 15 mm., $\frac{5}{8}$ inch, external to the cervix. Having traversed the plexuses above described, they curve inward in close contact to the anterior vaginal wall and enter the bladder at the lateral angles of the trigone.

Within the mucous membrane of the uterus are lymph-spaces. About the vessels of its muscular walls are perivascular sheaths forming lymph-sinuses. Beneath the peritoneal covering is a rich plexus of lymphatic vessels. (Plate VIII.) The lymph from the body of the uterus ultimately reaches the lumbar glands; that from the cervix enters the iliac chain.

The Vessels of the Fallopian Tubes. The ovarian arteries arise from the aorta and descend to the lateral pelvic walls. Each enters the broad ligament of its own side, and is guided by the ligamentum infundibulo-pelvicum to the hilum or attached border of the ovary. Along this it pursues a tortuous course, and, leaving it, inclines upward and inward to reach the cornu of the uterus between the round ligament and the Fallopian tube. It gives branches to the ligament, the tube, and the ovary, and supplies the fundus of the uterus, anastomosing with the uterine artery. The isthmus and the fimbriated extremity of the tube are supplied by branches given off directly from the parent trunk. The ampulla is, for the most part, supplied by offshoots from the branches which are distributed to the ovary.

The larger subdivisions of the ovarian arteries are accompanied by veins.

PLATE VIII.

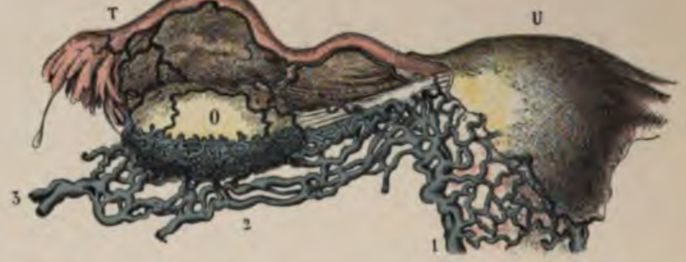


Lymphatics of the Gravid Uterus and Appendages. (Savage.)

1, *2*, superior lumbar glands; *3*, inferior lumbar glands; *4*, sacral glands; *5*, external iliac glands; *6*, common iliac glands; *7*, ovarian plexus; *a*, left renal artery; *b*, left renal vein; *c*, left ovarian vein; *d*, left ovarian artery; *e*, aorta; *f*, common iliac artery; *g*, ascending vena cava; *h*, external iliac artery; *k*, common iliac vein; *m*, *n*, ureters; *o*, right common iliac artery; *p*, iliacus muscle; *s*, psoas magnus muscle; O, ovary reversed to show lymphatics; K, kidney; *T*, Fallopian tube.

PLATE IX.

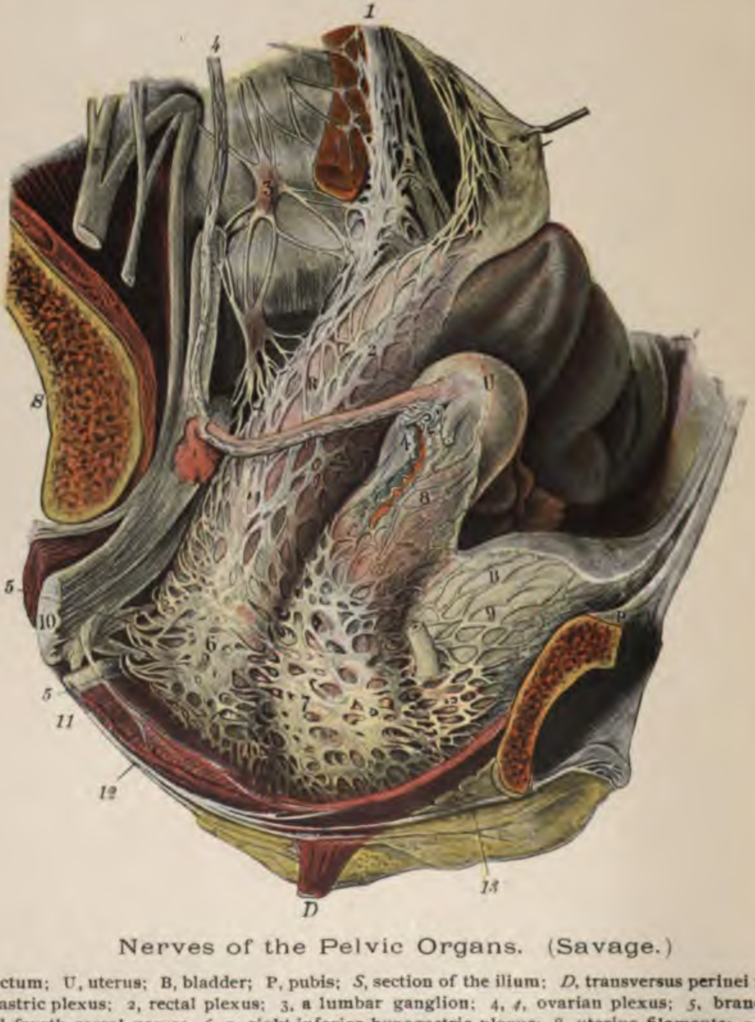
Fig. 1.



Bulb of the Ovary and its Venous Communications. (Savag

O, ovary; T, Fallopian tube; U, uterus.
1, uterine vein and plexus; 2, subovarian venus plexus; 3, commencement of ovarian vein.

Fig. 2.



Nerves of the Pelvic Organs. (Savage.)

R, rectum; U, uterus; B, bladder; P, pubis; *S*, section of the ilium; *D*, transversus perinei mus
1, hypogastric plexus; 2, rectal plexus; 3, a lumbar ganglion; 4, *4*, ovarian plexus; 5, branch f
third and fourth sacral nerves. 6, 7, right inferior hypogastric plexus; 8, uterine filaments; 9, ve
plexus; 10, great sciatic nerve; *11*, levator ani branch from fourth sacral nerve; *12*, pudic nerve; *13*,
tribution of pudic nerve to clitoris.

The arrangement of the bloodvessels, as well as of the lymphatics, in the Fallopian tubes is similar to that in the uterus.

The Vessels of the Ovaries. The branches of the ovarian arteries which supply the ovaries are exceedingly tortuous, even to their minute subdivisions. They cover the surfaces of the ovaries and enter them at the hila. Those entering the glands form, in the zonæ vasculosæ, rich capillary networks about the ovisacs. The veins emerging at the hila enter plexuses "in which the ovaries and ovarian ligaments seem to be partly embedded" (Savage). (Plate IX., Fig. 1.) To these plexuses is sometimes applied the name of "the bulbs." Upon each side the blood from the bulb, the Fallopian tube, and the body of the uterus enters an extensive venous plexus surrounding the ovarian artery. This is the *pampiniform* (tendril-like) *plexus*, and is drained by the ovarian vein.

The ovaries are rich in lymphatics. The efferent vessels are joined by those from the uterus and by those from the tubes. They form plexuses within the folds of the broad ligaments, and the lymph from them enters the lumbar glands.

The Nerves of the Uterus, Tubes, and Ovaries. The uterus is supplied by branches from the inferior hypogastric plexuses of nerves, though branches from the ovarian plexus as well reach its fundus. The inferior hypogastric plexuses supply the Fallopian tubes also. The ovaries receive their nerve-supply from the ovarian plexus. The method of termination of the nerves in the ovaries is undetermined. They have been traced into the hilum, where they form a network about the vessels. Some investigators claim to have traced them to the Graafian follicles.

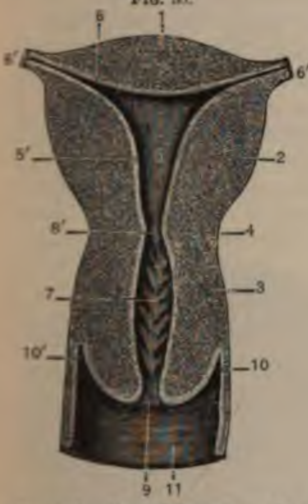
The Inferior Hypogastric Plexuses. The *inferior hypogastric* are also called the *pelvic* plexuses. (Plate IX., Fig. 2.) They are situated at the sides of the rectum, the bladder, and the vagina. In their distribution their branches accompany the internal iliac arteries. The plexuses are formed by filaments from the hypogastric plexus of the sympathetic joined by nerves from the sacral ganglia and branches of the second, third, and fourth sacral nerves. The nerves which supply the vagina accompany the vaginal arteries. They are derived almost entirely from such parts of the inferior hypogastric plexuses as come from the cerebrospinal axis. The nerves which supply the vaginal fornix, the cervix uteri, the body of the uterus, and the Fallopian tubes accompany the uterine arteries, and upon them may be demonstrated ganglionic enlargements.

The Ovarian Plexus. The *ovarian plexus* is derived from the renal and aortic plexuses of the sympathetic system. It surrounds the ovarian arteries, and in its distribution accompanies its branches.

The Uterus. The *uterus* is a pyriform body, but it differs in form and dimensions in non-parous and in parous women. That of the adult virgin when removed from the body weighs between 32 grammes and 42 grammes, 1 to 1¼ ounce. Its entire length is about 7.5 cm., 3 inches. Near the centre of its length it presents a constriction, the *isthmus*. This marks the division of the organ into *body* and *cervix*. The superior portion is the *body*, and the inferior the *neck* or *cervix*. Somewhat less than three-fifths of the entire length of the uterus belongs to the body. The sagittal diameter at the centre of the body is 2.5 cm., 1 inch, and that at the centre of the cervix very little less. The greatest transverse

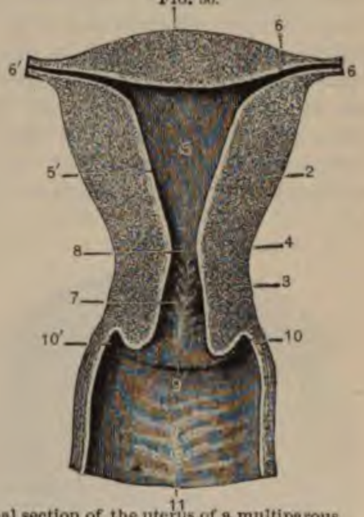
internum. Under normal conditions in the non-gravid uterus it barely admits a probe 3 mm., $\frac{1}{8}$ inch, in diameter. The os internum is situated at the inferior angle of the cavity of the body of the uterus. Into the lateral angles open the Fallopian tubes. It has already been stated that the cervix uteri projects into the upper and anterior part of the vaginal vault. The attachment of the vagina to it has led to its division into a supravaginal and an infravaginal portion. This attachment of the vagina to the cervix is such as to render these portions of about the same length anteriorly. Posteriorly, however, the supravaginal portion is somewhat the longer. The anterior lip of the cervix is, therefore, apparently the longer of the two.

FIG. 35.



Coronal section of the uterus of a nulliparous woman.

FIG. 36.



Coronal section of the uterus of a multiparous woman.

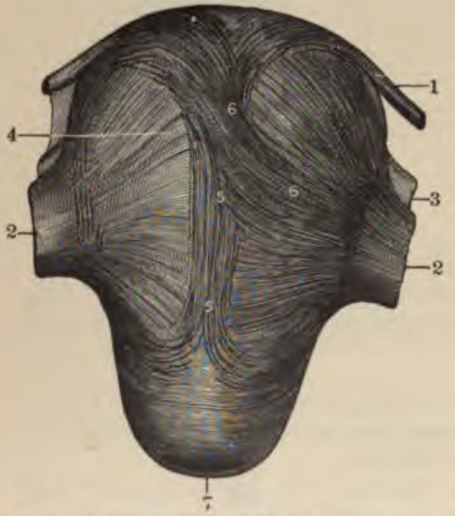
1. Fundus. 2. Lateral walls of the body. 3. Cervix. 4. Isthmus. 5. Cavity of the body. 5'. Internal wall of the body. 6. Cornu. 6'. Opening of the Fallopian tube. 7. Arbor vitæ. 8. Os internum. 9. Os externum. 10, 10'. Lateral fornices. 11. Posterior vaginal wall. (TESTUT.)

The cervix of the virgin is conical in shape and is firm to the touch. That of the parous woman is longer and more nearly cylindrical, and the os tincæ is patulous and irregular in outline.

As a result of childbearing the body of the uterus is somewhat enlarged, and the difference between its sagittal and its transverse diameters is diminished. Its cavity is more capacious and less markedly triangular in outline. The whole organ is so changed that the body is relatively longer as compared with the cervix. Their lengths now are a little more than 2.5 cm., 1 inch, for the cervix, and a little more than 5 cm., 2 inches, for the body. The weight of the organ is increased by about 50 per cent.

The uterus is essentially a muscular organ. It is lined with mucous membrane and partially invested with peritoneum. Its walls are of an average thickness of 1 cm., $\frac{3}{8}$ inch. Though the fibres interlace in such a manner as to be inseparable except in the gravid uterus, anatomists are almost universally agreed that they are arranged in three distinct layers. They are of the unstriated or involuntary variety, and have interposed between them connective-tissue cells. The *external* muscular layer or stratum is exceedingly thin, and can be demonstrated upon such parts of the uterus only as are covered by the peritoneum, and with this it is intimately connected. The fibres of this layer pass from the anterior and the posterior surfaces and from the fundus upon the Fallopian tubes, the round and the ovarian ligaments, and accompany such parts of the peritoneum as form the broad and the utero-sacral ligaments. The *internal* muscular layer is so intimately connected with the mucous membrane as to be, by some, described with it, for, except in the cervix, there exists in the uterus no submucosa. The fibres of this layer have a circular arrangement. They are augmented at the orifices of the Fallopian tubes, at the os externum, and at the os internum. Those at the os internum are considered as forming a sphincter muscle. The *middle* muscular layer constitutes much the greatest part of the structure of the uterus, and is continuous with the muscular coat of the vagina. It is of an average thickness of 6 mm., ¼ inch. The fibres have no definite arrangement, but interlace in every direction. They develop in size enormously during gestation. This stratum is exceedingly vascular.

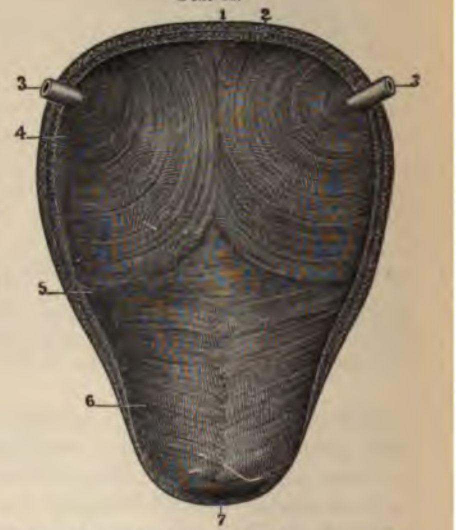
FIG. 37.



External muscular layer of the uterus, seen upon the anterior surface of the organ.

1. Tube. 2. Origin of round ligament. 3. Origin of ovarian ligament. 4. Transverse fibres. 5. Longitudinal fibres forming the anterior branch of the ensiform fascicle. 6. Fascicle in Z-shape. 7. External orifice of the cervix. (TESTUT.)

FIG. 38.



Internal muscular layer of the uterus, seen after removal of the external and middle layers.

1. Section of external muscular layer. 2. Section of middle muscular layer. 3. Fallopian tubes. 4, 5, 6. Variously disposed fibres. 7. Os externum. (TESTUT.)

The coats of the vessels are so intimately held to the muscular fibres by connective tissue that the veins remain patulous on cross section.

The walls of the uterus are thickest over the fundus and at the sides of the organ. They diminish in thickness at the isthmus and as the Fallopian tubes are approached.

The cavity of the uterus is lined throughout with mucous membrane. This is continuous with that lining the Fallopian tubes, with the external mucosa of the infravaginal part of the cervix, and with that lining the vagina. It differs in thickness and character in different parts of the organ. Its average thickness is 1 mm., $\frac{1}{25}$ inch. Over the central part of the cavity of the body it is 2 mm., $\frac{1}{12}$ inch, thick, and 3 mm., $\frac{1}{8}$ inch, in the cervix. In this latter location, as has already been intimated, it is more loosely attached to the underlying structure. Contrary to the arrangement in most of the hollow viscera, and probably by reason of its firmer attachment to the muscular wall, the mucous membrane of the body of the uterus is not thrown into folds or rugæ, except, possibly, at the cornua. It is of a dark-red color. That of the cervix contrasts decidedly with that of the body. The former is lighter in color, is firmer to the touch, and is thrown into plicæ or folds. It should also be noted that the transition from the mucosa of the body to that of the cervix is not gradual but abrupt. The line of demarcation is at the os internum. To a peculiar arborescent arrangement of the folds of mucous membrane in the cervix uteri has been given the name ***arbor vitæ uterini*** (*plicæ palmatæ*). On the anterior and on the posterior walls of this cavity is a median longitudinal ridge from which the plicæ extend upward and outward. As in the vagina, the markings upon the anterior wall are the more distinct, and parturition has the effect of partially obliterating them upon both walls. It has been claimed by Guyon that the ridges upon the one wall are so arranged as to fit into the depressions upon the other, thus more completely occluding the cervical canal.

Thickly scattered over the surface of the cavity of the body of the uterus are the openings of glands. The glands were originally infoldings of the mucous membrane, but have been developed into distinct tubules, frequently descending into the underlying muscular structure. They may be simple follicles or have branching extremities. The ducts may be straight, or may take a spiral course, but their axes are always obliquely inclined to the intra-uterine surface. The walls of the uterine glands consist of prismatic or columnar epithelium, supported upon a delicate basement membrane. The cells, as well as those of the surface, which are also of the same variety, are held together by connective tissue, and the connective tissue supports the vessels of the mucous membrane. The epithelium of the body of the uterus is provided with cilia. They are difficult of demonstration, since they are easily detached and soon thereafter lose their characteristic motion. The direction in which they propel is downward.

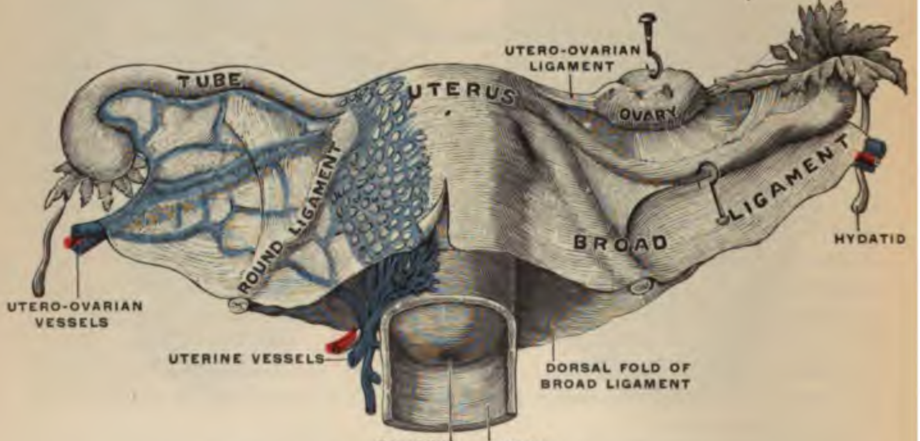
The mucous membrane of the cervical canal is thicker and firmer than that of the body, but is less intimately attached to the subjacent tissue. Differences which relate to the circulation will be considered hereafter. The presence of papillæ, though claimed by Henle, is denied by Klein. The glands are of the racemose variety. They are lined by cuboidal, non-ciliated epithelium. When their ducts are obstructed the imprisoned secretion forms cyst-like bodies upon the surface of the membrane. These bodies have been designated the *ovula of Naboth*. They are pathological in character. The surface cells are of the columnar variety to within a few lines of the os externum. Here they change, by a dentated border, to the variety covering the intravaginal surface of the cervix. The cells upon the summits of the plicæ are ciliated, while those in the furrows are devoid of these processes (Klein). The plicæ are absent in the lower sixth of the canal. This has led to the erroneous statement that the epithelium of the upper part of the cervical canal is ciliated, while that of the lower part is not.

The mucous membrane covering the intravaginal surface of the cervix uteri is smooth, closely adherent to the subjacent tissue, and, according to Quain, is destitute of glands. It is covered with pavement epithelium.

Ligaments of the Uterus. The uterus, during its development, may be considered as pushing its fundus upward beneath the peritoneal bag, so that this membrane partly covers its anterior and its posterior surfaces. This extensive serous membrane is reflected from the bladder upon the anterior surface of the uterus at about the level of the isthmus. It passes upward over the fundus and downward over the posterior wall to the vaginal attachment. It is intimately connected with the external muscular stratum of the body of the uterus, so much so as to have led anatomists to describe the organ as having a peritoneal coat. The anterior wall of the cervix above the vaginal attachment and below the isthmus is connected to the bladder by fibro-cellular tissue.

The peritoneum covering the uterus extends outward from the whole length of each side of the body of that organ to the pelvic wall. The attachment to the pelvis is "from the great sciatic notch downward along the obturator foramen to the level of the spine of the ischium." These two folds of peritoneum, one upon each side, constitute the *broad ligaments of the uterus.* Each ligament consists of two layers of peritoneum reinforced by subperitoneal areolar tissue and by muscular fibres from the external stratum of the uterus. The broad ligaments together with the uterus constitute a partition by which the pelvic cavity is divided into an anterior and a posterior recess, the deepest parts of which are the vesico-uterine pouch and the cul-de-sac of Douglas, respectively.

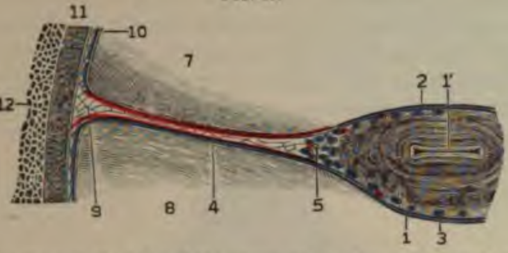
Fig. 39.



The uterus and adnexa viewed from the front. (Testut.)

The vesico-uterine folds constitute the *anterior ligaments of the uterus* or the *vesico-uterine ligaments.* The recto-vaginal folds form the cul-de-sac of Douglas and constitute the *posterior* ligaments of the uterus. Bounding the cul-de-sac on the sides are crescentic folds of peritoneum. They extend from the upper part of the cervix uteri, or a little higher in parous women, to the rectum and past it to the second sacral vertebra. They are known as the *utero-sacral ligaments.*

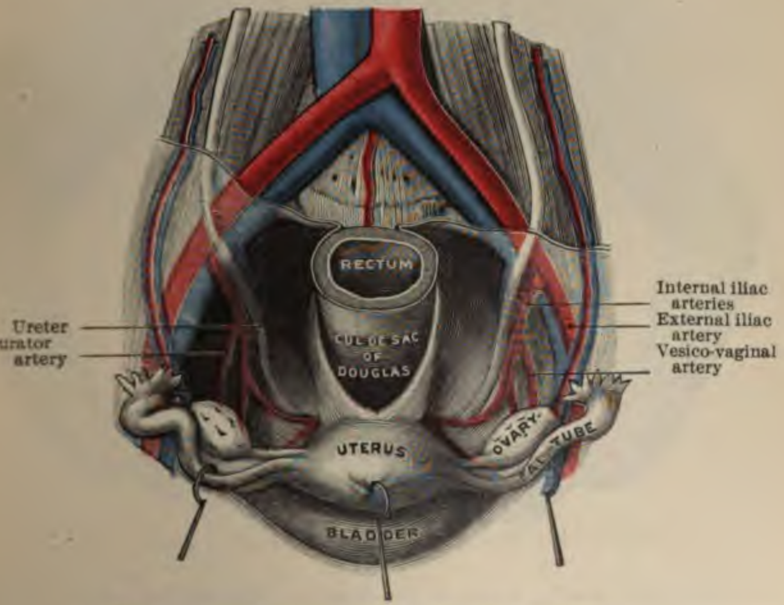
Fig. 40.



Horizontal section through the body of the uterus and the base of the right broad ligament.

1. Body of the uterus. 1'. Cavity of the uterus. 2. Peritoneum covering the posterior wall of the uterus. 3. Peritoneum covering the anterior wall of the uterus. 4. Broad ligament. 5. Uterine artery. 7. Post-uterine cavity. 8. Pre-uterine cavity. 9. Subperitoneal areolar tissue. 10. Parietal peritoneum. 11. Obturator internus muscle. 12. Ischium. (Testut.)

Fig. 41.



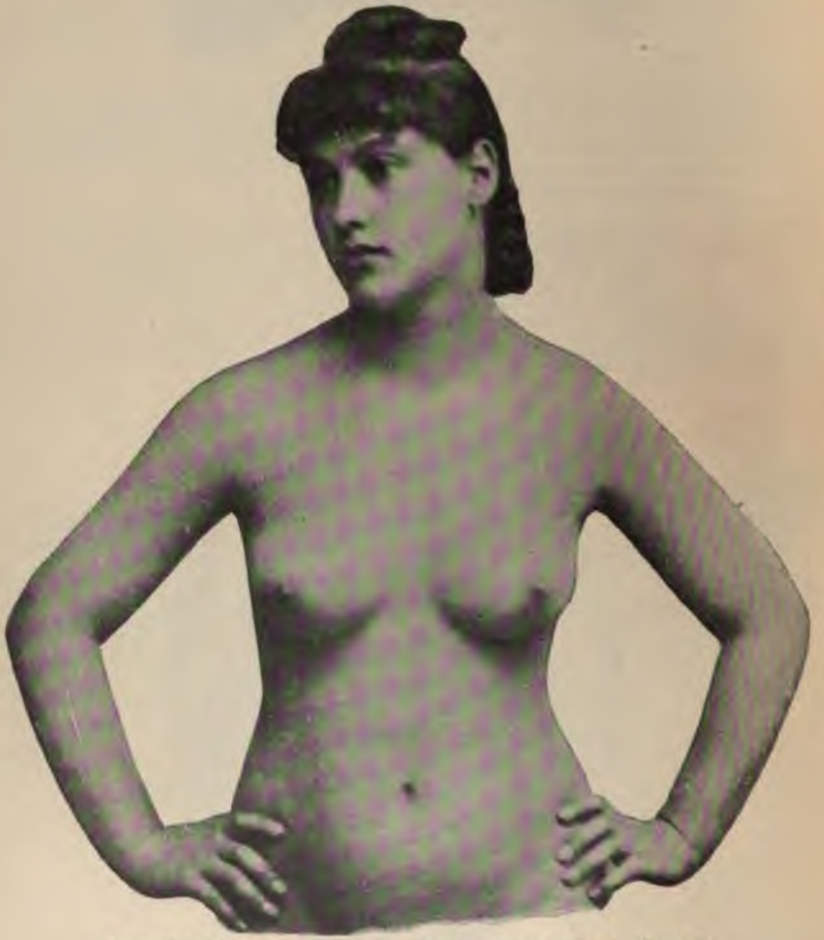
The utero-sacral ligaments or folds of Douglas. (Testut.)

Webster calls attention to the fact that they run backward from the uterus in a direction practically parallel with the vagina. Like the broad ligaments, the utero-sacral ligaments are reinforced by fibrous and muscular elements.

THE MAMMARY GLANDS.

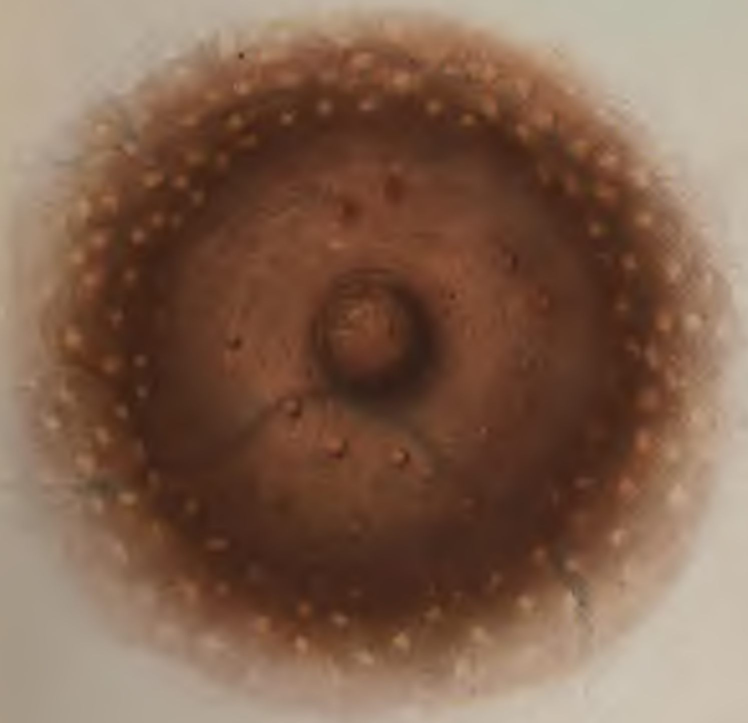
The mammary glands exist in males and in females alike. There is little or no difference between them in the sexes during infancy and childhood. As the age of puberty approaches the gland of the female undergoes a rapid and characteristic development. That of the male remains rudimentary throughout life, although rare exceptions to this rule exist. The location of the mammæ upon the anterior chest-wall has obtained for them the common name of the *breasts*. Embryology teaches that the glandular structure is a modification of the sebaceous glands. Supernumerary mammæ may, therefore, occur as accidents of development. When existing they are usually small and located upon the chest or in the axillæ. They may, however, attain considerable size and may be formed upon other parts of the body.

FIG. 42.



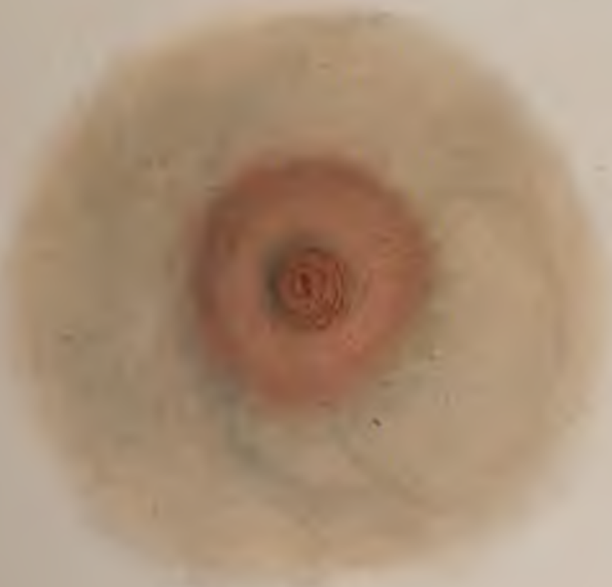
Breast of virgin, showing pink areola and position of gland. (DENNIS.)

PLATE X.



BREAST OF DARK BRUNETTE, NEAR TERM.
From Life.

PLATE XI.



BREAST OF BLONDE IN LATER MONTHS OF PREGNANCY.
From Life.

The female breasts differ in size and in appearance in different individuals. These differences depend upon age, race, condition in life, nutrition, and the activity or quiescence of the gland. In the same person, the left breast is generally somewhat larger than the right.

In a well-developed, non-parous white woman the breasts appear as hemispherical or conoidal masses, one upon each side. In the negress they are pendulous. They are firm to the touch. Each is about 5 cm., 2 inches, in thickness. The circumference of its base is slightly elliptical, the major axis being directed upward and outward toward the axilla. Internally it overlaps the border of the sternum. Externally it is bounded by the mid-axillary line. Vertically it is bounded above by the second or third rib, and below by the sixth or seventh rib. Its weight averages 175 grammes, or between five and six ounces.

At the most prominent part of the breast is the *nipple* or *mammilla*. It usually appears as a conical wart-like excrescence. Sometimes it is flattened and ill-defined, or its site may be marked by a depression. Surrounding the nipple is a zone of modified integument. It is designated the *areola*. The areola is about 2.5 cm., 1 inch, in width. The color of the nipple and of the areola varies with the complexion of the individual. In blondes they are a rosy pink; in brunettes a delicate brown. Though the nipple is slightly below the centre of the breast, it points upward and outward when the body is in the upright position. This is due to the sagging of the base of the gland. The nipple is then about opposite the fourth intercostal space.

The skin of the nipple and of the areola differs from that of the rest of the breast and from skin generally. That of the nipple is tough and leathery. It is beset with numerous sensitive papillæ, is wrinkled from the presence within it of unstriped muscular tissue, is supplied with large sebaceous glands, is destitute of hairs or of sweat-glands, and is perforated near its centre by the openings of the milk-ducts. The skin of the areola is delicate in texture. It is abundantly supplied with sudoriparous glands. Hair follicles are present. The sebaceous glands are markedly developed. They open upon little elevations which give to the areola a tuberculated appearance. Near the base of the nipple the ducts of a variable number of accessory milk-glands open upon the areola.

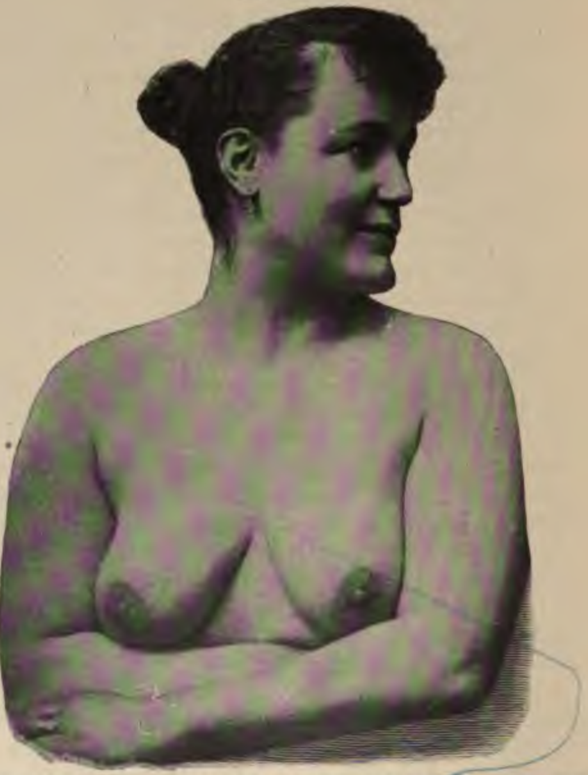
As the first pregnancy advances the breasts increase in size. The nipples also enlarge and become cylindrical in shape. The areolæ widen and undergo deeper pigmentation. The sebaceous glands of the areolæ become more active. The elevations marking their ducts become more prominent. They are now known as the glands of Montgomery. During lactation the breast may weigh, according to Testut, as much as 500 grammes, or over fifteen ounces.

After lactation the breasts decrease in size, but do not regain their former appearance. They lose firmness and become soft and pendulous. The nipples remain prominent and the areolæ wide. In blondes the areolæ may assume their original color, but in brunettes they remain deeply pigmented.

The mammary gland is made up of from twelve to twenty lobes, each of which may be considered a distinct gland. The lobes are pyramidal in form, their apices being represented by ducts which discharge at the nipple. They are encapsulated by a fascia which sends processes between them and between the lobules of which they are composed. The capsule of the mammary gland is concave toward the chest-wall. It is attached to the fascia of the underlying muscles by connective-tissue bands. These may enclose lymph-spaces, the so-called *submammary bursæ*. Occasionally little masses of glandular tissue perforating the capsule lie embedded in the pectoral muscle.

Internally the breasts lie upon the pectoralis major muscles; externally and below they overlap the interdigitations of the serratus magnus with the external oblique muscles; externally and above they are separated from the serratus magnus muscles by the axillary fasciæ.

FIG. 43.



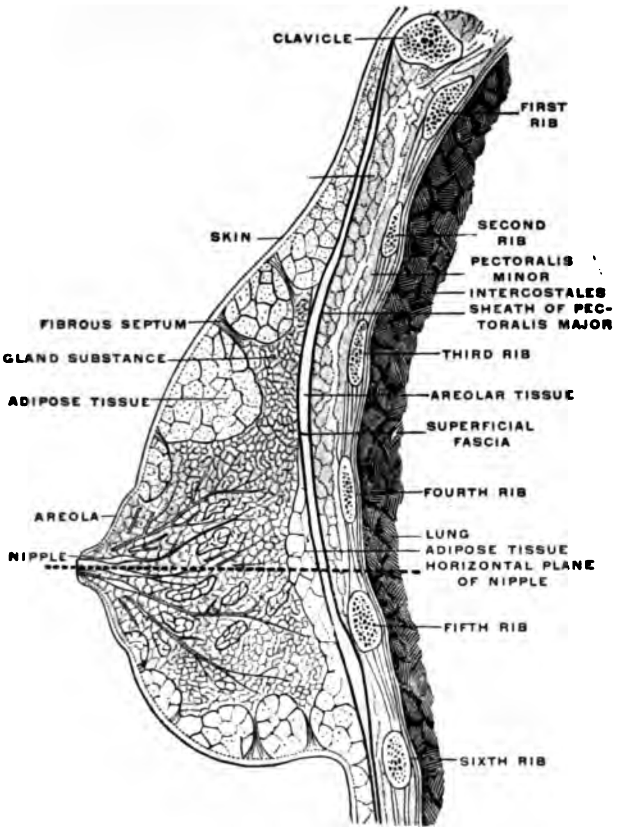
Breast of woman who has been pregnant, showing pigmented areola and position of gland. (DENNIS.)

The convex surface of the capsule enclosing the lobes is uneven. It sends processes to the overlying skin known as the *ligaments of Cooper*.

Except beneath the nipple and the areola the superficial fascia of the breast contains fat. Fat is also found in the fascia between the lobes. Upon the quantity of fat depends in a great measure the size of the breasts. Beside the lobes constituting the gland proper, minute glandular bodies may be found near the base of the nipple. They are the so-called *accessory glands*. They are from five to twelve in number. Their ducts may open independently upon the surface of the areola or may open into the principal ducts traversing the nipple.

The glandular tissue of the breast may be distinguished from the surrounding fat by its pinkish color and its firmer consistence. Each lobe is a compound racemose gland, and consists of a number of lobules. The lobules are surrounded and supported by fibrous connective tissue derived from the interlobular septa. Each lobule consists of ultimate *acini* or *alveoli* arranged about a central canal. The canals unite to form the interlobular ducts. The interlobular ducts unite to form the principal duct of the lobe. This is the *tubulus lactiferi*, or *galactophorous duct.*

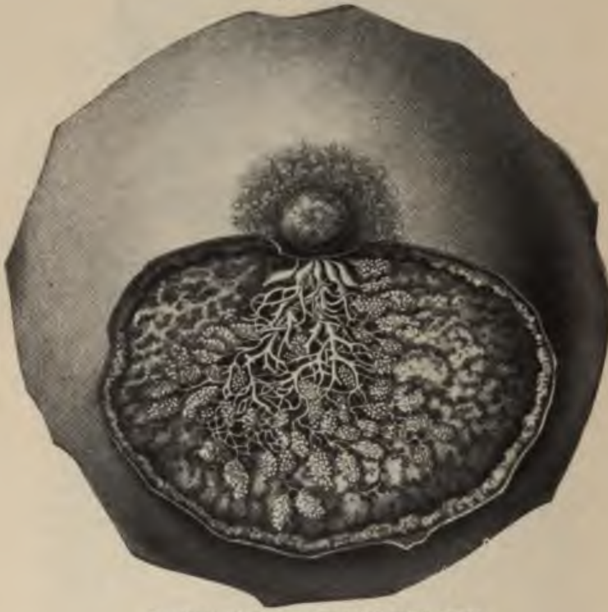
FIG. 44.



Sagittal section of mamma and chest-wall. (TESTUT.)

Before lactation and during subsequent periods of functional inactivity the acini are small and undeveloped. They consist of a membrane (*membrana propria*) enclosing a mass of granular polyhedral cells. During pregnancy they enlarge, and the central cells soften. At the commencement of lactation the central cells are discharged as colostrum corpuscles. The peripheral cells are of the short columnar variety and line the membrana propria. The walls of the ducts are of areolar tissue, in which elastic fibres are disposed in both a circular and a longitudinal manner. Quain states that there is no muscular tissue in the walls of the ducts. This is certainly not true of the larger ducts. Near the nipple the tubuli lactiferi show the presence of unstriped muscular fibres interlacing and taking courses both circular and longitudinal. The latter may be traced for a certain distance into the lobes, and some investigators even claim to have discovered stray fibres in the interlobular ducts. The epithelium of the ducts varies in different parts of the gland. That of the lobular and interlobular ducts resembles the epithelium of the acini. That of the main duct is distinctly cylindrical, except very near its termination, where it changes to the squamous variety.

FIG. 45.



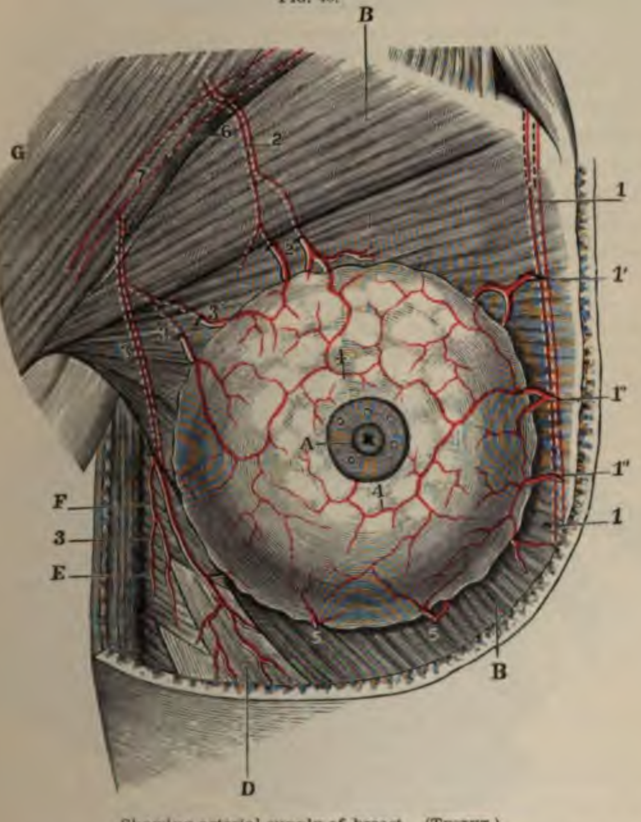
Anatomical arrangement of milk-ducts.

When formed by the union of the interlobular ducts the tubuli lactiferi converge toward the nipple. Beneath the areola they form sac-like dilatations or *ampullæ*. During lactation the ampullæ are about 12 mm., ½ inch, in length, and 6 mm., ¼ inch, in diameter. They act as reservoirs for the milk secretion during the intervals of suckling. Beyond the ampullæ the ducts contract in size and lie side by side in the nipple. The central ones are somewhat the larger. All open independently of one another and by contracted mouths at depressions upon the apex of the nipple.

The arteries of the breast are numerous but small. They do not accompany the ducts, but enter at the base of the gland. The inner and greater portion of the breast is supplied by the internal mammary artery, the anterior or perforating branches of which pierce the intercostal spaces to reach it. The anterior intercostal branches of the internal mammary artery and the aortic intercostals with which they anastomose, in like manner supply the inner portion of the mammary gland. The outer portion gets its blood-supply from the axillary artery through its long thoracic and acromio-thoracic branches. To the long thoracic branch of the axillary artery is frequently applied the name *external mammary*. An accessory external mammary branch may also be given off from the axillary artery and go to the supply of the breast. A rich capillary network is found upon the outer walls of the acini.

The blood is returned from the breast through superficial and deep veins. The deep veins accompany the arteries for the most part. The superficial veins form an anastomosing circle at the base of the nipple (*circulus venosus* of Haller). They spread over the surface of the breast and end in the superior thoracic vein. The superficial veins are especially noticeable during lactation.

FIG. 46.



Showing arterial supply of breast. (TESTUT.)

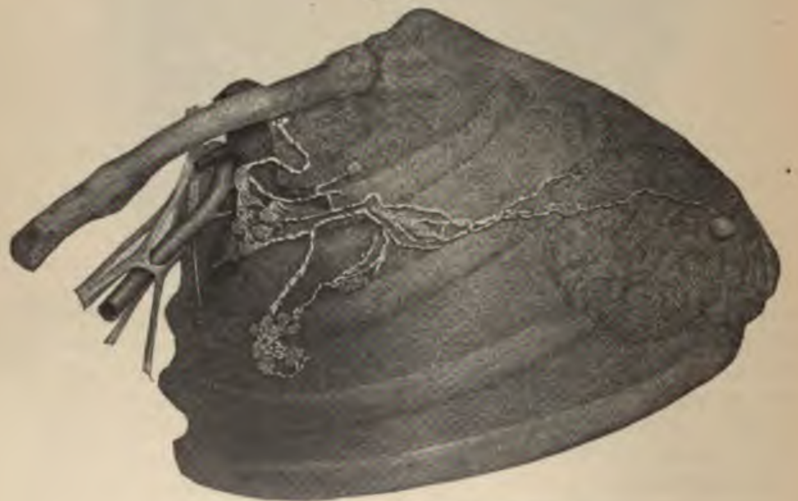
A. Mammary gland. B. Pectoralis major muscle. D. External oblique muscle. E, F. Digitations of serratus magnus muscle. G. Deltoid muscle. 1. Internal mammary artery. 1', 1''. Perforating branches of the same. 2. Superior thoracic artery. 2'. Branches of the same. 3. Long thoracic artery. 3'. Branches of the same. 4. Superficial vessels of the breast. 5. Perforating branches from the aortic intercostal arteries. 6, 7. Axillary artery.

The nipple is exceedingly vascular, and the vessels are surrounded by bundles of unstriped muscular tissue. The contraction of the muscular fibres upon stimulation compresses the vessels and causes the so-called erection of the nipple. It is not to be understood, however, that the nipple contains any true erectile tissue.

The lymphatics of the breast are abundant. They form plexuses in the connective tissue about the acini and between the lobules. They are found accompanying the smaller vessels and in the sheaths of the larger ones. All freely communicate. There are, beside, sac-like dilatations in the skin and fascia, from which cutaneous and subcutaneous lymphatics originate. The lymphatics from the inner portion of the breast accompany the perforating arteries and empty into the mediastinal glands. Those from the outer portion unite and form three or four large trunks. They proceed to the axillary glands. A few canals from the vicinity of the nipple empty into a gland situated beneath the outer border of the clavicle.

The nerve-supply to the breast is principally from the intercostal nerves through the lateral cutaneous and the anterior terminal branches. The descending branches of the superficial cervical plexus also contribute cutaneous filaments. The glandular twigs which accompany the ducts to the acini have been traced by Eckhard from the fourth, fifth, and sixth intercostal nerves. On account of the free communication between the spinal nerves and the gangliated cord, sympathetic nerves are conducted to the mammary gland. "In the nipple many nerves end in tactile corpuscles in the papillæ, and some of those in or near the areola enter Pacinian corpuscles" (Quain).

FIG. 47.



Lymphatics of breast and axilla. (COOPER.)

In the periods between lactation the acini collapse, but do not return to their former undeveloped condition, and the connective tissue contains a greater amount of fat than before the gland became functionally active. At the close of the child-bearing period the whole structure undergoes atrophy, so that in old age the glandular tissue has practically disappeared.

PART II.

PHYSIOLOGY OF PREGNANCY.

CHAPTER II.

MENSTRUATION.—OVULATION.—DEVELOPMENT OF THE OVUM.

MENSTRUATION.

THIS is the periodical discharge of blood from the uterus which takes place during the whole of genital life—the years included between puberty and the climacteric—the period of pregnancy excepted. In occasional instances menstruation may also occur during the early months of gestation, but after the fifth month, when the decidua reflexa has joined the vera and disappeared, the normal source of the discharge is completely shut off, and bleeding from the uterus subsequent to this time must be due either to a diseased condition of the cervix or to some other pathological condition of the uterine tissues.

Menstruation occurs on the average once in twenty-eight days, but it is subject to wide variations in point of time, some women menstruating normally at shorter, others at longer, intervals. The duration of the flow is usually from three to five days, but it may continue for two or three days longer and still remain within normal limits. Every healthy woman must be considered a law unto herself in the matter of frequency and duration. The source of the flow is the mucous membrane of the uterine fundus and body.

At first the discharge is made up of mucus, epithelia, and some blood; later it consists of nearly pure blood, and finally of a diminishing amount of blood, serum, epithelia, granular débris, and some fat. The reaction of the discharge is acid from the presence of phosphoric and lactic acids; it is non-coagulable from the admixture of mucus; and it has a peculiar penetrating odor due to contained fatty acids. From four to eight ounces are lost at each period.

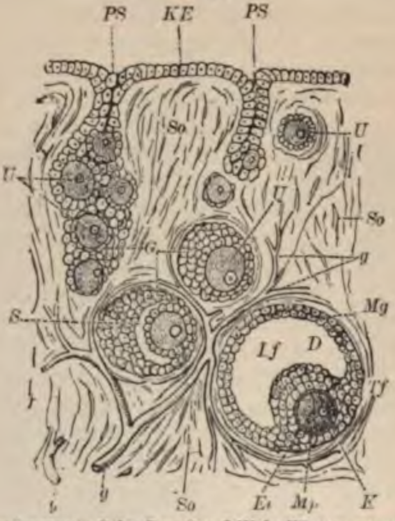
The function is associated with more or less general and local disturbance, especially of a secondary or reflex character.

The primary cause of the flow is to be sought in the ovary, viz., in ovulation. The processes affecting the uterus during the menstrual act may be considered as taking place in four stages, as follows: (1) A period of construction in which the uterine mucosa becomes tumefied, the stroma is infiltrated with serum which often contains blood, the vessels are dilated, and the number of epithelial cells lining the glands is augmented, while the glands themselves become dilated and filled with mucus. This condition is probably similar to that which follows impregnation, the swollen mucous membrane in this instance being called the *decidua menstrualis.* (2) A period of destruction in which the integrity of the uterine lining is destroyed, the exposed capillary vessels rupture and pour out their blood, which carries with it the products of disintegration. (3) A period of regeneration in which the swelling and hyperæmia subside, and the uterine lining is rapidly renewed by the proliferation of the stroma cells and the upgrowth of the epithelial cells of the glands. This takes place between the sixth and the eighteenth day from the beginning of the period (Westphal). These changes are followed by (4) a period of quiescence or repose, in which no active changes take place in the uterine lining.

OVULATION.

This consists in the periodical discharge of the fully ripened ovum from the Graafian follicle, and, like menstruation, is probably confined to the period of genital life. The development of the egg-cell from the germinal epithelium is described elsewhere. The young ovum is at first surrounded by a single layer of small cells, but by division of these a wall several cell-layers deep is finally formed. Between the external and the innermost layer a fissure is then developed, the latter becoming filled with fluid—the *liquor folliculi*. The innermost layer of cells is thus forced away from the wall, and as the fluid increases a vesicle is formed, the cells adhering around the ovum as the *discus proligerus*, which remains attached to the follicle wall at one point only, the farthest from the surface. The wall of the Graafian follicle is composed of the following layers from within outward: (*a*) *membrana granulosa;* (*b*) the *membrana propria*, a very thin basement membrane; (*c*)

FIG. 48.



Development of the Graafian follicle (WIEDERSHEIM).

KE. Germinal epithelium, from which Pflüger's tubes, *PS*, in ovarian stroma are developed. *So.* Ovarian stroma. *g, g.* Small vessels. *U, U.* Primitive ova. *S.* Space between membrana granulosa and ovum. *Lf.* Liquor folliculi. *D.* Discus proligerus. *Ei.* Ripe ovum, with germ-vessicle and germinal spot (*K*). *Mp.* Membrana pellucida. *Tf.* Muscular sheath of follicle. *Mg.* Membrana granulosa.

the *tunica propria*, which carries the smaller bloodvessels and is composed of more or less fibrous tissue; and (*d*) the *tunica fibrosa*, containing much fibrous tissue, and through which run the larger bloodvessels.

At one place in the follicle wall (the *stigma*) no bloodvessels are developed, and it is at this point that rupture occurs and permits the escape of the ovum surrounded by the discus proligerus, now called the *corona radiata*, and the liquor folliculi. Just before rupture of the follicle certain preparatory changes take place, the maturation of the follicle, which lead up to the event. The bloodvessels become engorged, the internal layer of the wall becomes thickened and is thrown into folds, and the liquor folliculi is largely augmented. At this time the Graafian follicle projects from the surface of the ovary as a currant-like cyst.

After the escape of the egg-cell the follicle undergoes certain changes, the nature of which is dependent upon the fertilization or otherwise of the ovum, the product in either instance being the *corpus luteum*. When fecundation of the ovum does not take place the corpus luteum of menstruation, *corpus luteum spurium*, is formed. The bursting of the follicle relieves the pressure on the surrounding bloodvessels, which rupture into the cavity, the discharged blood forming a firm clot, the *corpus hæmorrhagicum*, which, however, does not become attached to the follicle wall. Spindle-shaped connective-tissue cells and large cells containing pigment-granules now penetrate the clot, and the follicle wall becomes thickened and thrown into folds, thus encroaching more upon the central clot. Contraction of the clot follows, and capillary loops surrounded by newly formed cells from the follicle wall enter its substance. As these changes progress the granules of *lutein* in the external layer of the clot give rise to its yellow appearance. The further changes in the corpus luteum are of a retrograde character, the clot and newly formed products gradually disappearing, until after eight or nine weeks only a small cicatrix on the surface of the ovary remains. It is stated by Dalton that seven or eight months may elapse before total obliteration of the follicle takes place.

In the event of impregnation, the corpus luteum of pregnancy—*corpus luteum verum*—results. Under this condition, instead of diminishing in size, the corpus luteum continues to enlarge up to the fourth month, the walls becoming thicker and their convolutions more numerous. From the fourth to the seventh month a stationary period occurs, but from this time on the corpus luteum begins to decline, so that at term it is much smaller than at the fourth month. After labor the retrograde changes are rapid, and by the eighth or ninth week post partum nearly all traces of the corpus have disappeared.

Although menstruation and ovulation should not be considered as necessarily coincident processes, it is altogether probable that the conditions which influence the one have also an effect upon the other, and that, as a rule, the two functions occur simultaneously, and are to a greater or less extent interdependent.

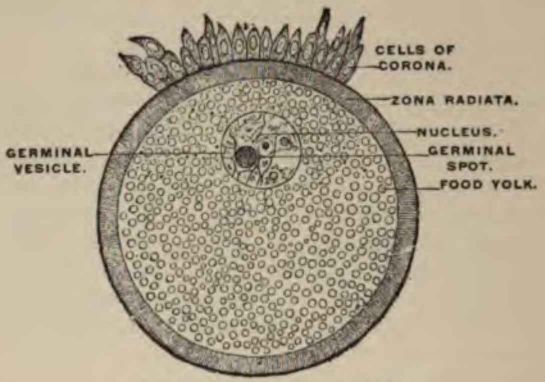
DEVELOPMENT OF THE OVUM.

Maturation; Fertilization. The fully developed human ovum is a single cell, more or less spherical in form, about 0.2 mm. ($\frac{1}{125}$ inch) in diameter, and composed of a yolk, a nucleus, a nucleolus, and two enveloping membranes. (Fig. 49.)

The outermost membrane, *Zona radiata* or *Zona pellucida*, in the mature ovum is rather thick and tough, and presents a striated appearance, owing to the presence of numerous minute pore-canals, through which nutrition is supposed to be furnished the ovum. It is derived from the secretions of the ovarian tissues.

The second, or *Vitelline membrane*, lies in close contact with the yolk from which it is developed, and is a very thin and delicate covering.

FIG. 49.



Rabbit's ovum (after WALDEYER).

Between the zona and the second membrane there is a narrow cleft, the *Perivitelline space*, which permits free motion of the ovum within its external covering.

The *Yolk* or *Vitellus* is a clear, somewhat granular substance, consisting of yolk-grains (food-yolk or deutoplasm), some fat granules, and protoplasm. The latter is usually increased in amount at one point in the ovum, around the nucleus, and this part is designated the animal pole, while the corresponding opposite point, where the protoplasm is less, is known as the vegetative pole.

The *Nucleus* of the ovum, also called *germinal vesicle* or *vesicle of Purkinje* from its discoverer, occupies an eccentric position in the egg-cell, and is surrounded by a nuclear membrane. A reticulum or network of achromatic threads radiates from the nucleolus through the interior of the nucleus; the meshes of this structure are filled with a clear fluid, the nuclear sap.

The *Nucleolus, Germinal spot* or *spot of Wagner*, is also placed eccentrically in the nucleus, and is largely composed of chromatin—a substance having a marked affinity for staining reagents.

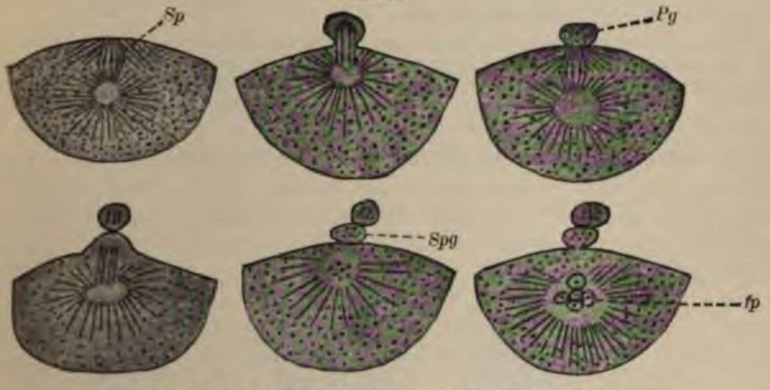
Maturation of the Ovum. The female cell or ovum, thus briefly described, although fully developed, is still in an unripe condition, unprepared for the reception of the male fecundating element, and must undergo a series of changes, which principally affect the nucleus and nucleolus, before fertilization can be accomplished. These changes are known as the *maturation* of the ovum, and take place just before or just after the ovum has escaped from the Graafian follicle, occurring without reference to the future fate of the egg-cell.

The first step in the process of maturation is the contraction of the entire yolk. The nucleus then travels toward the animal pole of the egg, loses its sap, which becomes mingled with the surrounding protoplasm, and the nuclear membrane shrinks and finally disappears. Achromatic threads then appear in the nucleus in the form of a spindle-shaped body, which lies parallel with the surface of the egg, each thread bearing a chromatic granule near its middle, which gives rise to the appearance of a dark band near the centre of the nuclear spindle.

A clear space at each end of the spindle then develops threads which run to the surrounding yolk substance, the sun-like appearance thus produced being termed the *Amphiaster*.

The nuclear spindle now assumes an upright position, the chromatin granules divide, each half travelling toward its corresponding end of the spindle, while the spindle itself surrounded by protoplasm advances to the surface of the egg and pushes outward one-half of its entire substance into the perivitelline space. This extruded portion then becomes constricted off from the rest of the spindle, and forms the first *polar globule*. (Fig. 50.)

FIG. 50.



Formation of polar globules in arteria gracialis (after O. HERTWIG).

Sp. Nuclear spindle. *Pg*. First polar globule. *Spg*. Second polar globule. *fp*. Female pronucleus.

The remnant of the spindle in the egg then a second time undergoes the changes just described, and forms in the same manner a *second polar globule*. Three-fourths of the original spindle is thus cast off. The remnant of the spindle retires into the egg, disappears temporarily, and is then re-formed as the *female pronucleus*.

No entirely satisfactory explanation for the formation of the polar globules has been advanced; but it is supposed to be effected either to lessen the size of the cell nucleus in order to make room for the male element, or to prevent self-fertilization, parthenogenesis.

Fertilization. The ovum, now fully ripe and in condition for fertilization, migrates through the Fallopian tube toward the uterus. The point at which the two elements, male and female, meet, is not definitely known, but it is supposed to be the outer portion of the tube in the majority of instances.

Recent observations go to show that impregnation may take place anywhere from the Graafian follicle in the ovary to the cavity of the uterus.

Of the whole number of ova which are discharged from the ovary it is quite probable that many do not enter the tube at all, but fall into the peritoneal cavity and perish. In very rare instances the ovum from one ovary is known to have passed entirely around the uterus, and entering the tube of the opposite side to have there become fertilized.

When the spermatozoa and ovum meet, the former penetrate the zona radiata, and the first spermatozoon which approaches the vitelline radially is met by a slight protrusion of the protoplasm of the egg, which it penetrates and, passing inward, enters the yolk. Here the spermatozoon loses its tail, and the head, composed largely of chromatin, becomes the *male pronucleus.*

But one spermatozoon is necessary for fertilizing the ovum, and as soon as this has penetrated the yolk a repellent action seems to be set up by the latter, whereby other spermatozoa are prevented from passing inward.

After a short resting stage the male and female pronuclei approach each other, and, their walls coming in contact, fuse, finally disappear, and a single nucleus, somewhat smaller than the original one of the ovum, remains as the *segmentation nucleus.*

The ovum now enters upon a new stage of development, in which the entire egg-cell is broken up into a great number of smaller cells, each of which possesses a nucleus. This total division of the ovum is known as *holoblastic segmentation*, the individual cells of which are called *blastomeres.* (Fig. 51.) This change first affects the segmentation nucleus which divides by the indirect method (karyokinesis), and forms two nuclei. A groove then appears in the axis of the ovum, marked by the polar globules, which by continuous deepening completely divides the ovum into two cells. A second meridional cleavage plane divides the two cells into four, the four are then divided into eight, then into twelve segments, and, the process continuing, the ovum is finally converted into a mass of cells, which, from its resemblance to the fruit, is called

FIG. 51.

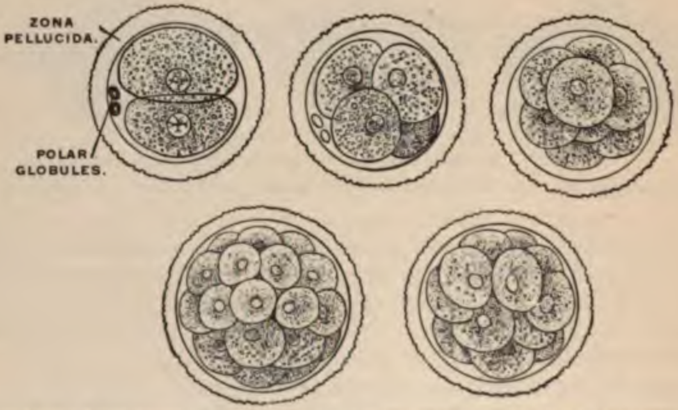
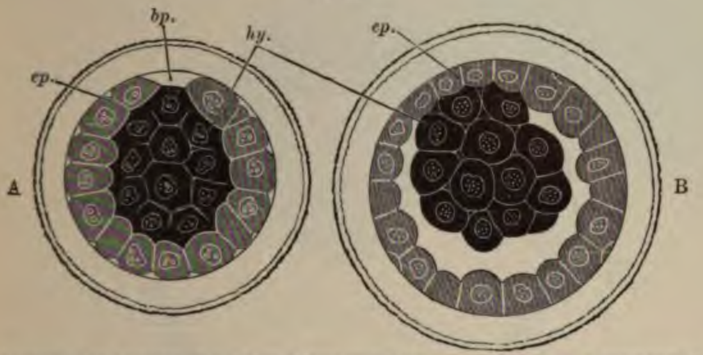


Diagram showing first stages of segmentation in a mammalian ovum (ALLEN THOMPSON, after E. VAN BENEDEN).

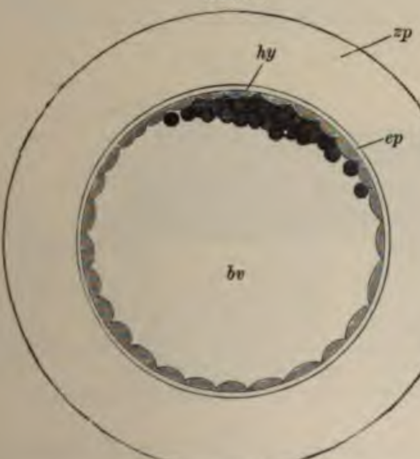
the *Morula* or mulberry-body. The process of cell division, although described as equal, is not so in fact, for the external cells divide more rapidly than the internal, so that there can be differentiated two distinct layers, a superficial layer in which the cells are small, and an internal layer in which they are much larger. At about the time that the morula stage is reached a small cavity—the *segmentation cavity*—makes its appearance in the interior of the mass. This is later filled with a clear albuminous fluid, which increases rapidly in amount, so that the ovum soon becomes distended into a vesicle, the *blastodermic vesicle* or *blastula*. (Fig. 52.) On section the blastula is seen to consist of a cavity surrounded by a single layer of small cells, within which at one point a lens-shaped collection of larger cells is attached. (Fig. 53.)

FIG. 52.



Optical section of an oosperm of a rabbit, at two stages closely following upon segmentation (from Balfour, after Ed. v. Beneden): *ep*, ectoderm; *hy*, primary entoderm; *bp*, the opening in the ectodermic layer at one point, named blastopore by E. van Beneden; this is not a true blastopore. The shading of the ectoderm and entoderm is diagrammatic.

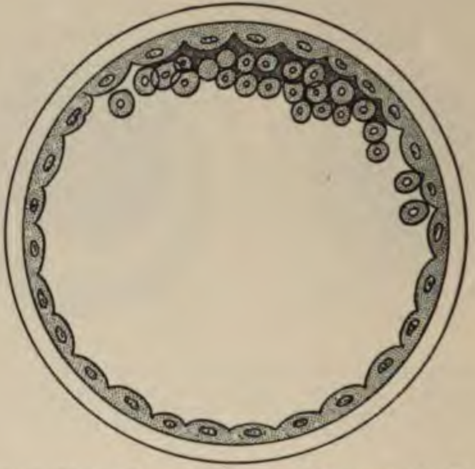
FIG. 53.



Rabbit's ovum between seventy and ninety hours after impregnation (after VAN BENEDEN).

With the growth of the blastula the cells of the external layer—Raubers's *covering layer*—become greatly thinned and flattened out, and ultimately either disappear or are united to the upper layer of cells of the inner cluster. (Fig. 54.) Thus there is at one stage of development an external thin layer of cells, which extends around the entire surface of the blastula, and a second and a third layer which do not so extend at this time.

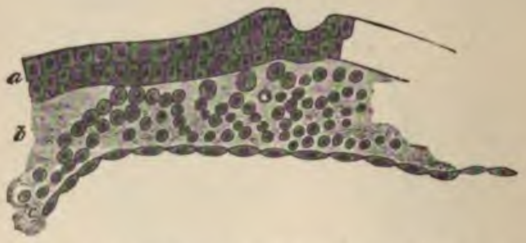
FIG. 54.



Later stages of segmentation in a mammalian ovum (THOMSON, after E. VAN BENEDEN).

The covering layer, as stated, disappears, the second layer becomes external, the *ectoderm*, and the third layer, now second, the *entoderm*.

FIG. 55.



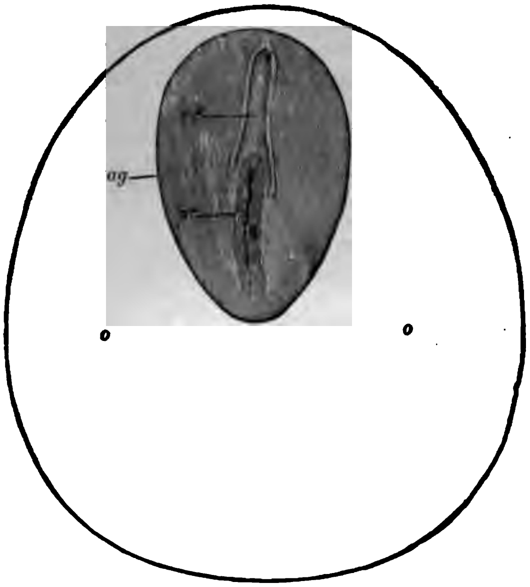
Transection of eighteen-hour chick embryo, showing beginning of medullary groove and the three layers (MANTON collection).

a. Ectoderm. *b*. Mesoderm. *c*. Entoderm.

From the cells of the two layers thus formed, a third layer—the *mesoderm*—is developed, and grows outward from the median axial line. (Fig. 55.) Unlike the other two layers the mesoderm does not at first extend entirely around the ovum, but is limited in growth by the germinal or embryonic area (Fig. 56), that portion of the egg in which the future embryo will be developed. The mesoderm grows in all directions, but as it extends cephalad it sends out two projections,

which, leaving a space (the *proamnion*) just in front of the future head, again unite and spread outward. (Figs. 57, 58, 59.)

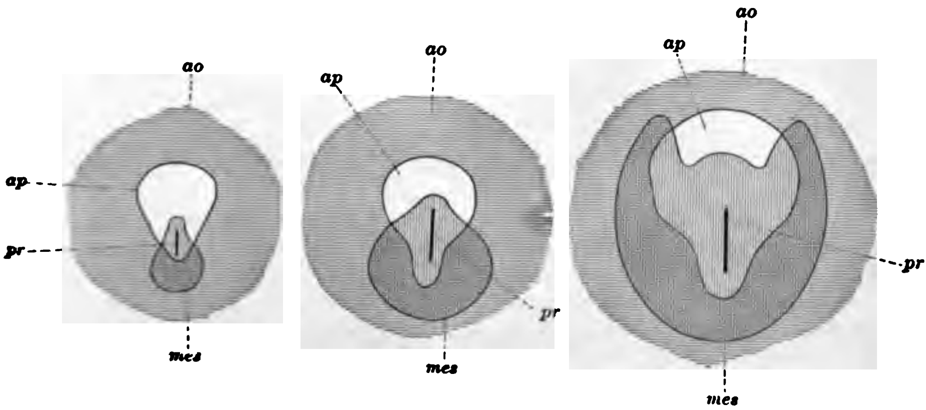
Fig. 56.



Embryonic area of rabbit (after Kölliker).

At a later period two distinct varieties of cells arise from the mesoderm—*mesothelium*, which possesses the characteristics of **endothelium—** and from this *mesenchyme* or embryonic connective tissue.

Fig. 57. Fig. 58. Fig. 59.



Diagrams of embryonic area of chick (after Duval).
***ao.* Area opaca. *ap.* Area pellucida, the proamnion in third figure. *pr.* Primitive streak. *mes.* Mesoderm.**

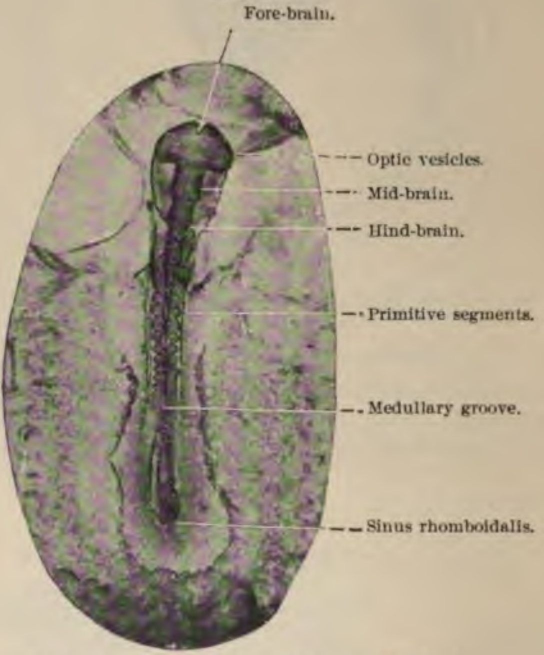
From the three primary layers all the parts and tissues of the body are developed.

From the **Ectoderm:** The skin and its epidermal structures—the mammary glands, hair, nails, epithelium of the cornea; the lens of the eye; the cerebrospinal system—the nerves and ganglia; the optic vesicles and nerve; cavity of the mouth, teeth, hypophysis; anus, chorion, amnion, placenta.

From the Mesoderm: The muscles, bones, connective tissue, peritoneum, pleuræ, pericardium, urogenital apparatus (kidneys, testes, uterus, Fallopian tubes, and ovaries), spleen, bloodvessels, blood, lymphatics, fat-cells, marrow.

From the Entoderm: The œsophagus, stomach, intestines, epithelium of digestive tract, thyroid and thymus glands, tonsils, lungs, liver, pancreas, bladder.

FIG. 60.



Chick embryo. Second day. (MANTON collection.)

At an early stage a linear streak—the *primitive streak*—(Fig. 56) makes its appearance just behind the centre of the embryonic area, and runs backward to near the margin of the shield. In front of the primitive streak the ectoderm thickens into a band of cells several rows deep on either side of the median axial line. These thickenings are the *medullary plates*. By the upgrowth of the edges of the plates a groove is formed—the *medullary groove*—which by the arching inward and uniting of the lateral folds is converted into a tube, the *medullary* or *neural canal*. The formation of the canal begins in the future cervical region of the embryo, and progresses most rapidly cephalad; the posterior portion, the end of which appears to embrace the beginning of the primitive streak, remains open for some time, and is known as the *sinus rhomboidalis*. (Fig. 60.)

The neural canal is the proton of the cerebro-spinal system, one-half of its entire extent entering into the formation of the brain. Immediately below the developing neural canal a rod of cells is formed in the entoderm, and extends from the future hypophysis to the anterior end of the primitive streak. This is the *notochord*, or chorda dorsalis (Fig. 61, 6 Cd.), a temporary structure which represents the primitive axial skeleton of vertebrates. Developed from the entoderm, the chorda is at first a part of that layer, but the latter soon growing under it becomes separated and assumes a position directly beneath the neural canal, with which, however, it does not unite.

On either side of the neural groove the mesoderm becomes thickened into two longitudinal bands—the *muscle plates.* That portion of the plate nearest the groove is thickest and is known as the segmental zone, while the external portion which thins toward the blastodermic wall is the parietal zone.

FIG. 61.

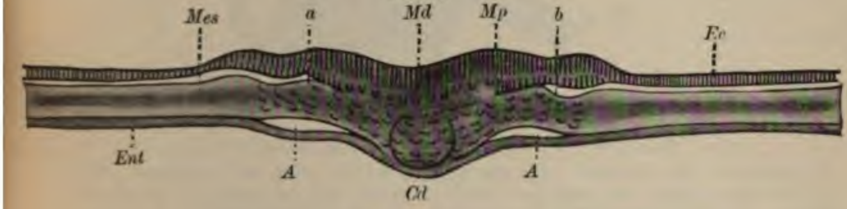


FIG. 62.

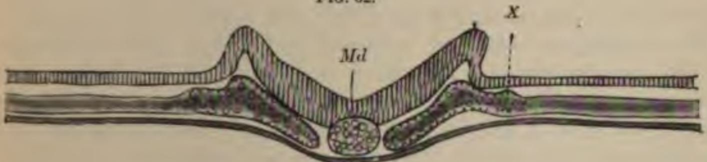


FIG. 63.

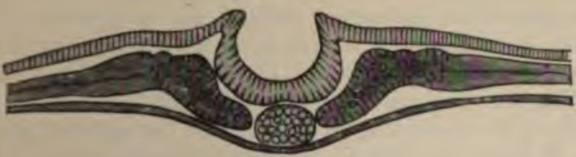
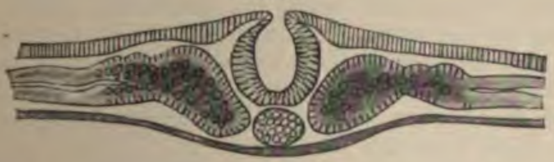


FIG. 64.



The segmental zone undergoes transverse cleavage which gives rise to a series of cubical bodies—the *myotomes* (see Figs. 61 to 66). These appear first in the neck region of the embryo, and gradually extend caudad. The myotomes give rise to most of the voluntary muscles of the trunk, and later to those of the extremities, and are indirectly connected with the formation of the future vertebræ.

FIG. 65.

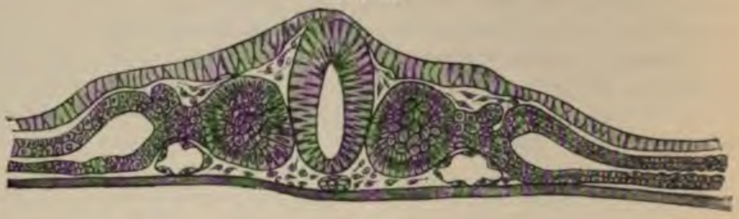
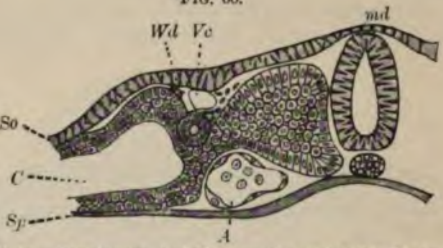


FIG. 66.



FIGS. 61-66.—Development of the neural canal (after WALDEYER).

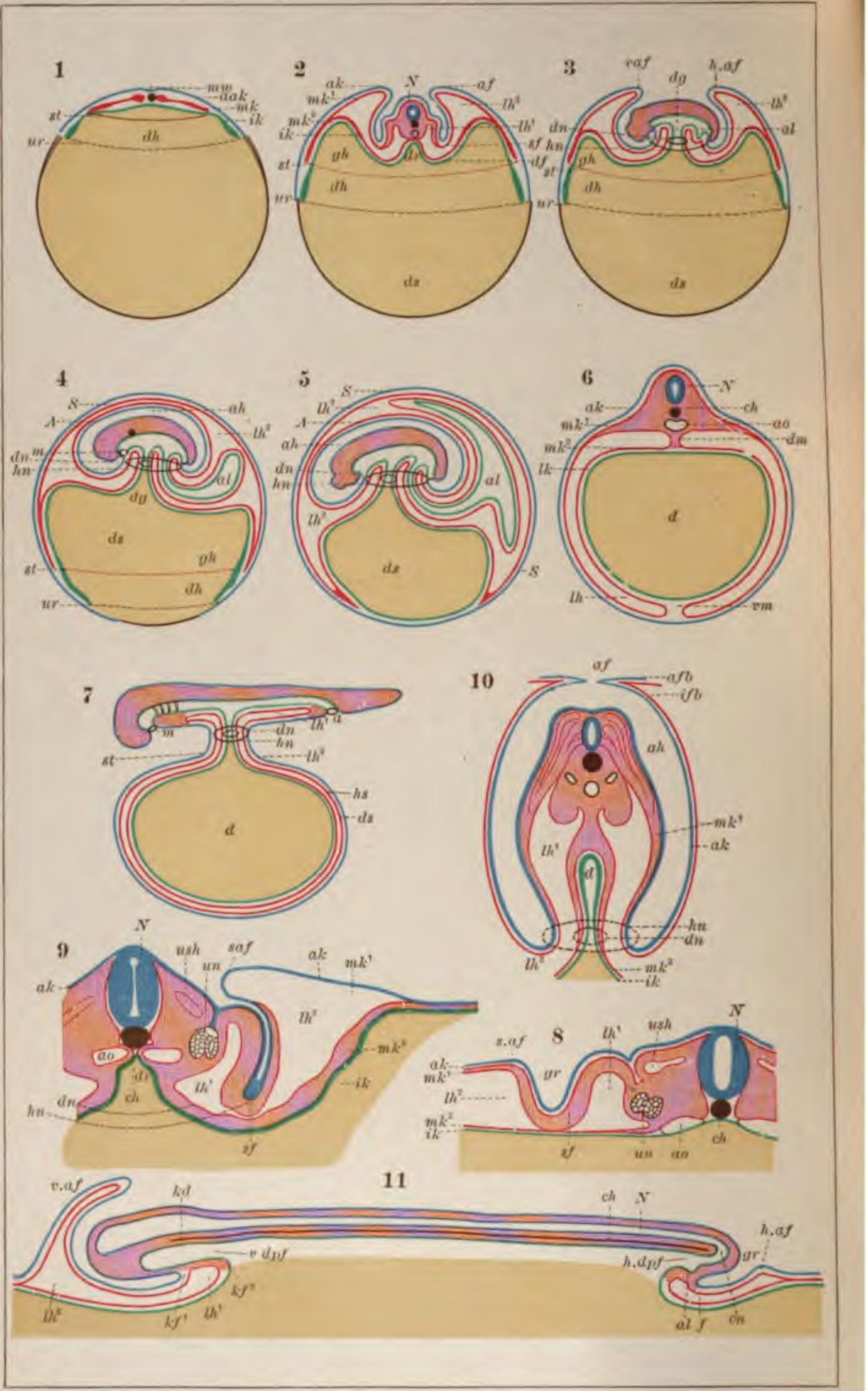
Ec. Ectoderm. *Ent.* Entoderm. *Mes.* Mesoderm. *a, b.* Prota of primitive segments (protovertebræ). *Md.* Medullary groove. *Mp.* Medullary plate. *A.* Aorta. *Cd.* Notochord. *X.* Wolffian ridge. *Wd.* Wolffian duct. *Vc.* Cardinal vein. *So.* Somatopleure. *Sp.* Splanchnopleure. *C.* Cœlom.

Externally to the parietal zone of the muscle plates, the mesoderm splits into two layers, an upper or external leaf going with the ectoderm to form the *somatopleure* or primitive body wall, and a lower or internal leaf which, with the entoderm, forms the *splanchnopleure* or primitive intestinal wall (see Figs. 61 to 66). The space between these two leaves is the *cœlom* or body cavity (pleuro-peritoneal cavity).

Folding off of the Embryo. Up to this time the embryo appears to lie flat on the blastodermic wall, but now changes arise which tend to carry it more and more from its surface position and to force it downward into the cavity of the blastula. A groove first appears just in front of the cephalic end of the embryo (Plate XII., Fig. 11), the *head fold,* and later one behind, the *tail fold,* and on either side the *lateral folds* are formed. As the result of the deepening of these folds, the embryo becomes partly constricted off from the rest of the blastodermic vesicle. As the folds deepen, spaces are shut off at the anterior and at the posterior ends of the embryo, immediately below the notochord. These cavities are the beginning of the primitive alimentary canal; that in front being the *fore-gut,* and that behind the *hind-gut.* The middle portion of this canal, as it soon comes to be, is still in connection with the yolk-sac or umbilical vesicle, by the wide omphalomesenteric or vitelline duct. (Plate XII., Figs. 3 to 10.)

The Fœtal Appendages and the Uterine Membranes. As the result of the folding off of the embryo, all of the extra-embryonic portion of the egg, which constitutes the yolk-sac, becomes partially constricted off as a pear-shaped body, which is connected by its smaller end to the primitive intestinal canal. At a later period the neck of the vesicle becomes

PLATE XII.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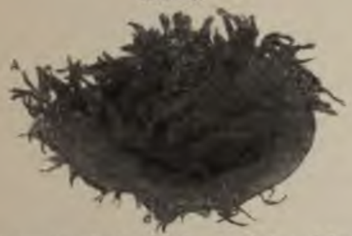
stretched out into a long thin pedicle, and pedicle and sac are finally incorporated in the abdominal stalk during the formation of the umbilical cord. The yolk probably supplies for a time partial nourishment to the embryo and its appendages. During its passage through the Fallopian tube the ovum also derives more or less nourishment from the secretions of the parts by which it is surrounded. As development of the embryo goes on a larger source of supply is demanded, to which end changes take place, bringing the embryo into direct relation with the maternal circulation, by which the necessary nourishment for growth and development is obtained.

At a very early period all of the extra-embryonic somatopleure becomes covered with a growth of delicate villi, which give it a shaggy appearance. This is the *primitive chorion ;* the whole ovum at this time is sometimes called the *chorionic vesicle*. (Fig. 67.)

FIG. 67.



Human ovum of second week, showing chorionic tufts, *A*. Enlarged four times. (MANTON collection.)

At first the villi are composed only of ectodermal cells, but later the mesoderm extends into each hollow villus. The whole chorion very early develops bloodvessels, but most of these soon become obliterated.

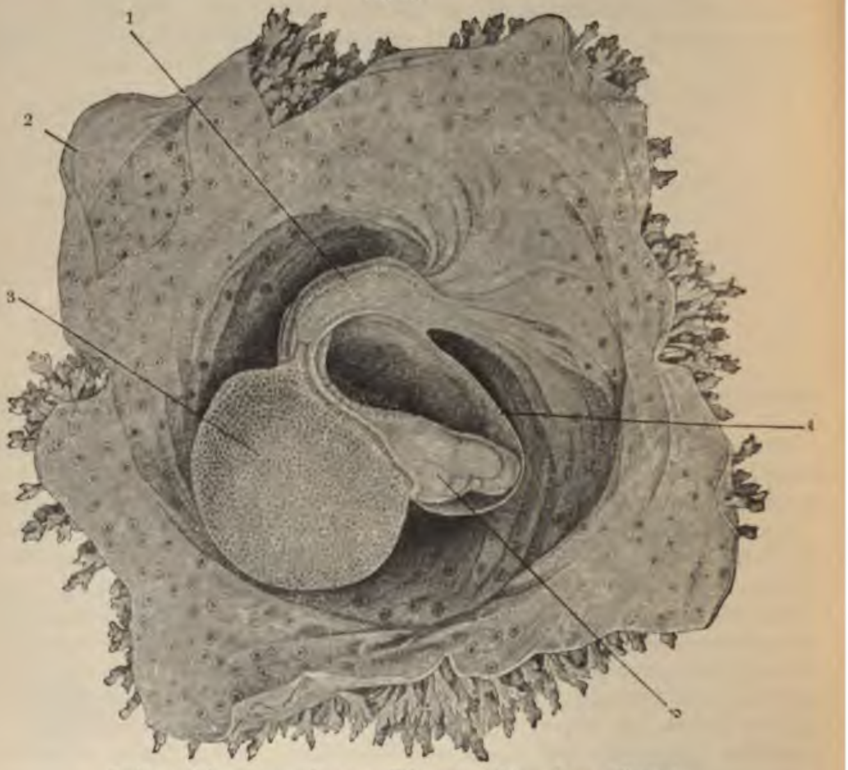
Coincident with the folding off of the embryo the external walls of the folds grow upward and, arching over the back of the embryo, unite in the mid-dorsal line. The anterior fold, cephalic cap, probably grows more rapidly than the lateral folds, but little is actually known regarding this phenomenon from observations on human embryos. The embryo in this way becomes inclosed in a thin membranous sac—the *amnion*. As will be seen by reference to Plate V., the amniotic folds are composed of two layers, an upper, external leaf—the *false amnion*—made up of ectoderm externally and lined with mesoderm, and a lower or internal leaf—the *true amnion,* which has a layer of mesoderm above and ectoderm below, and hugs the back of the embryo.

DESCRIPTION OF PLATE XII.

Folding off of embryo and formation of amnion and allantois in fowl's egg (after O. HERTWIG).
a. External germinal layer. *mw.* Medullary groove. *N.* Neural canal. *af.* Amnion fold. *vaf.* Anterior. *haf.* Posterior. *saf.* Lateral amniotic folds. *A.* Amnion. *ah.* Amniotic cavity. *S.* Serous covering. *hn.* Umbilicus. *sf.* Lateral folds. kf^1, kf^2. Head fold. *afb.* External. *ifb.* Internal layers of amnion. *ur.* Border of embryonic area. *dr.* Intestinal groove. *dg.* Vitelline duct. *al.* Allantois. *ds.* Vitellus. *dn.* Intestinal portion of umbilicus. *mk.* Middle germinal layer. mk^1. Parietal leaf of mesoderm. mk^2. Visceral leaf of mesoderm. *st.* Sinus terminalis. *dm.* Dorsal. *vm.* Ventral mesenterium. *lh.* Somatic cavity. lh^1. Embryonal portion. lh^2. Extra-embryonal portion of somatic cavity. Figs. 1, 2, 6, 8, 9, and 10 transections. Figs. 3, 4, 5, 7, and 11 longi-sections of embryo. Figs. 1, 2, 3, 4, and 5 chick embryo. Fig. 6 fish embryo. Figs. 7 and 11 selachian embryo.

The interval between the embryo and the true amnion later becomes the *amniotic cavity*. At first the amniotic membrane lies in contact with the back of the embryo, but soon a clear fluid, the amniotic fluid or *liquor amnii*, is secreted within the sac, and this increasing in amount rapidly distends the amnion until some time during the third month this membrane comes in contact with the chorion, with which it forms a loose attachment. The liquor amnii is a clear, serous fluid, having a specific gravity of 1007 to 1028, an alkaline reaction, and a composition including fixed solids, epithelial scales, lanugo, and other matters derived from the embryo or fœtus, besides water. It amounts to about one or two pints at term, and is probably largely derived by transudation from the maternal structures. The function of the liquor amnii is manifold: it maintains an equable distention of the uterus, protects the child from external violence, and permits of its free movements in utero; it prevents injurious pressure on the umbilical cord, and, during labor, softens and lubricates, as well as assists in the dilatation of, the parturient canal. It is, moreover, a source of water-supply to the fœtus, bathing its surfaces, and being swallowed in considerable quantities.

FIG. 68.



Embryo with open membranes. Fifteen to eighteen days. (COSTE.)

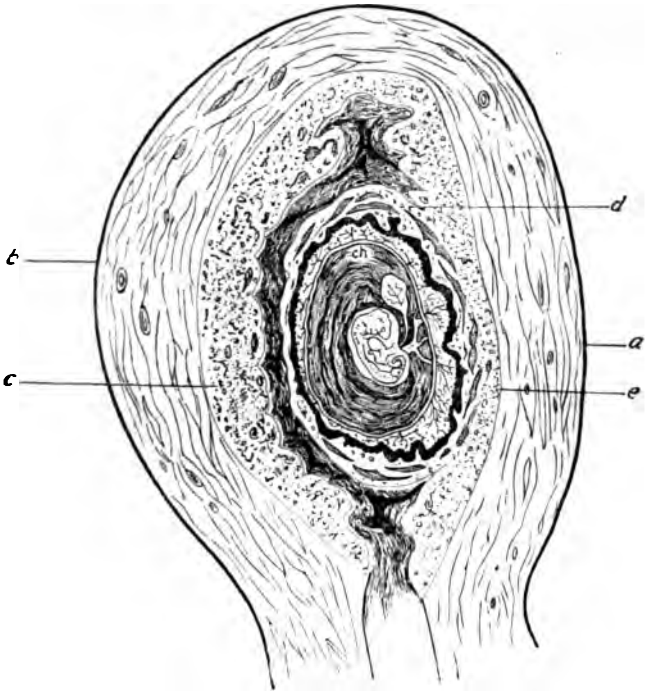
1. Allantois (abdominal stalk). 2. Parietal mesoblast. 3. Vitelline membrane, yolk. 4. Amnion. 5. Heart.

By the formation of the amnion the embryo becomes entirely separated

from the chorion except at its caudal end, which remains fixed as the *abdominal stalk.* (Fig. 68.) At an early period a bud-like diverticulum —the *allantois* (see Plate XII., 3 and 4)—develops from the posterior ventral end of the hind-gut, and growing outward soon reaches the chorion, with which it becomes joined and assists in the formation of the placenta.

The allantois lies beneath the abdominal stalk, and early in its development becomes attached to the lower surface of that part, the two together forming the proton of the umbilical cord.

FIG. 69.



Semi-diagrammatic outline of an antero-posterior section of the gravid uterus and ovum of five weeks (modified from ALLEN THOMSON).

a. Anterior uterine wall. *b.* Posterior uterine wall. *c.* Decidua vera. *d.* Decidua reflexa. *e.* Decidua serotina. *ch.* Chorion with its villi.

The impulse started by the fecundation of the ovum inaugurates certain changes in the uterus preparatory to the reception of the fertilized egg, changes which in their earlier stages are probably analogous to those taking place at the menstrual period. The whole uterus enlarges, becomes more vascular, and its mucosa appears more vascular, spongy, and swollen. At the os internum and the openings of the Fallopian tubes the mucous membrane remains thin, so that, as the result of hypertrophy, the parts surrounding these apertures are thrown into folds. The entire thickened lining of the womb is designated as the *decidua vera.* (Fig. 69.)

As soon as the chorionic vesicle enters the uterus, it is usually arrested in one of the folds nearest the tube opening, and at once attaches itself "by an unknown process of agglutination" (Minot) to the uterine wall. The folds by which it is surrounded then grow forward, arch over the vesicle, and their edges uniting, it becomes entirely enclosed as within a sac. These encompassing folds—the *decidua reflexa*—as the amnion expands are pushed more and more toward the decidua vera, with which they ultimately come in contact and unite during the fourth month.

The reflexa is a temporary structure and disappears by degeneration and absorption by the fifth month of pregnancy.

That part of the uterine mucosa upon which the chorionic vesicle first finds lodgement becomes the *decidua serotina;* it plays an important rôle in the future vascular arrangements between the mother and child.

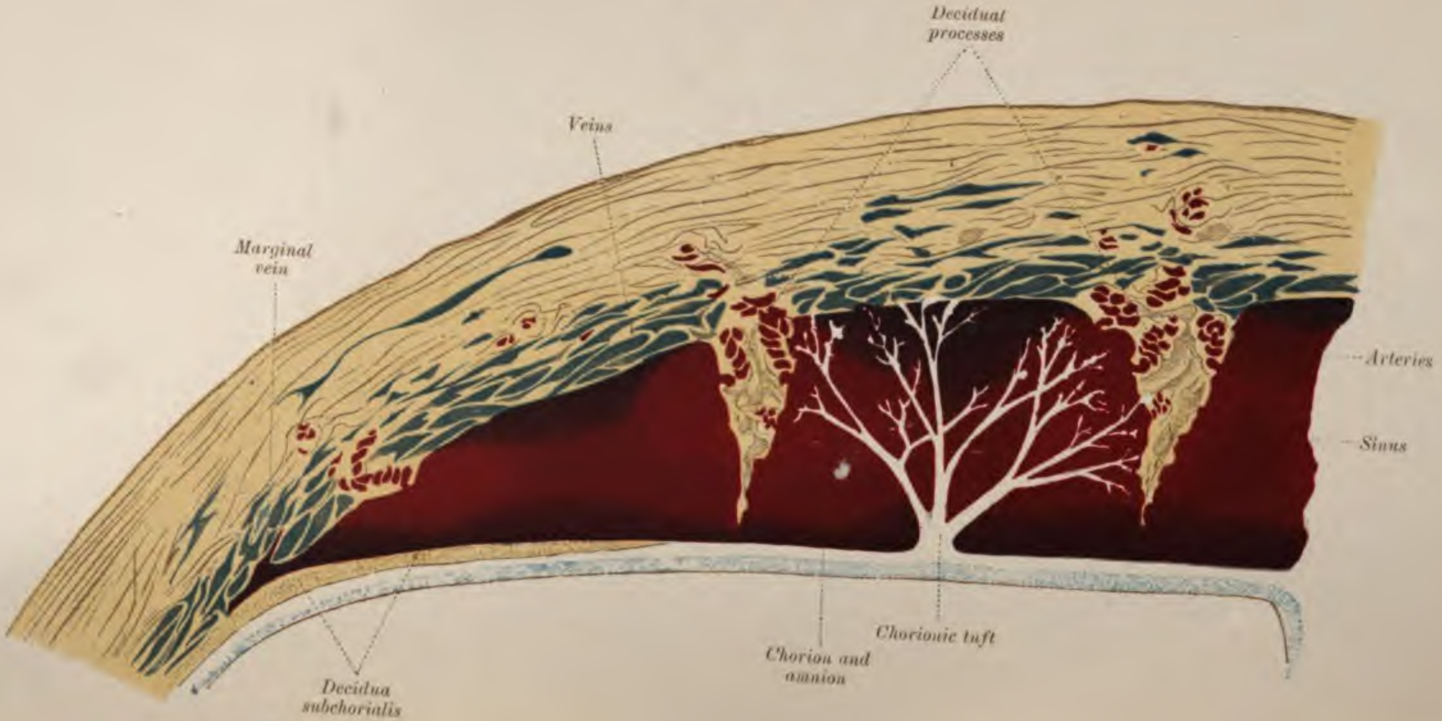
The Placenta and Umbilical Cord. When the chorionic vesicle reaches the uterus the tips of the villi penetrate the mucosa, and the embryo is at first nourished by osmosis from the maternal structures. The villi of the serotinal region, however, increase in size and repeatedly branch, and enter later into the formation of the placenta, so that this part has been called the *chorion frondosum.* The remainder of the villi of the chorion, called the *chorion læve,* gradually atrophy and disappear some time prior to the fourth month. At term the placenta or afterbirth (Figs. 70 and 71) is a roundish, oval, or kidney-shaped spongy mass, reddish-gray to deep purplish-red in color, with a diameter of six to eight inches, and weighs about a pound. It is usually thickest at the centre, and gradually thins off toward the edges, which are continuous with the amnion and decidua. The placenta consists of three essential layers: (1) A maternal zone of decidua, (2) a fœtal zone of amnion and chorion, and (3) a middle zone in which both the maternal and the fœtal elements are intimately associated.

The inner or fœtal surface of the placenta, to which the cord is attached excentrically, is smooth and glistening in appearance, and is covered by the amnion, beneath which the two umbilical arteries and one umbilical vein ramify in all directions. The veins are the larger and lie deeper and internal to the arteries. The external portion of the placenta presents a rough and irregular surface which in the recent state is covered with blood and clots. It is broken into asymmetrical patches or squares, the *cotyledons,* between which the decidua serotina dips down forming partitions or septa.

As already pointed out, the caudal end of the embryo is prolonged to the wall of the chorionic vesicle as the abdominal stalk. The latter, therefore, consists of the same structures as the remainder of the embryo, and possesses a rudimentary groove, a somatopleure, and a splanchnopleure. At first the amnion springs from the sides of the stalk.

By the down growth of the two somatopleural leaves and the uniting of their edges on the ventral side of the stalk, a tube is formed, the cavity of which is continuous with the cavity of the cœlom, and within which the allantoic diverticulum and the pedicle of the yolk-sac are imprisoned. As a result of the closing in of the tube, which is hereafter known as the *umbilical cord,* the amnion becomes separated from the abdominal stalk, the separation beginning at the embryonic end and extending to the chorionic attachment. Thus, as has been demonstrated by Minot, the umbilical cord is at no time covered by the amnion. The cavity of the cord becomes obliterated at an early stage, and the allantois and yolk-

PLATE XIII.



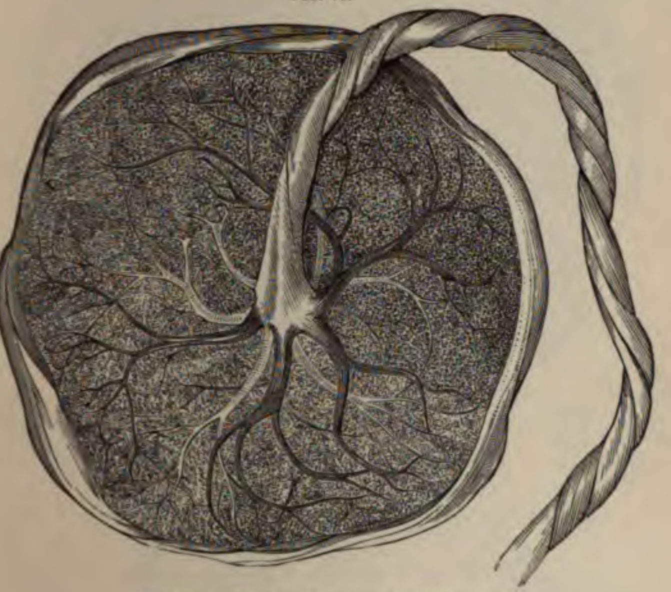
Utero-placental Circulation. (After Bumm.)
Section of Placenta.

stalk atrophy and disappear, although it is claimed by some observers (Kölliker, Minot) that the allantois can be distinguished at birth.

At term the cord has been compared to a "twisted rope of tissues," extending from the placenta to the child. The cord is of a glistening grayish-white color, of varying thickness, and is usually about 22 inches long, but may be either much longer or shorter.

In structure the cord consists of a covering of epithelium continuous with that of the amnion, which surrounds a jelly-like matrix called Wharton's jelly. This consists of mucin, branched corpuscles, and embryonic connective-tissue cells. Within this substance the two arteries and one vein run in a spiral course, usually from left to right; it is to the fact that the growth in length of the vessels exceeds that of the rest of the cord that the twisted appearance of the latter is probably due.

FIG. 70.

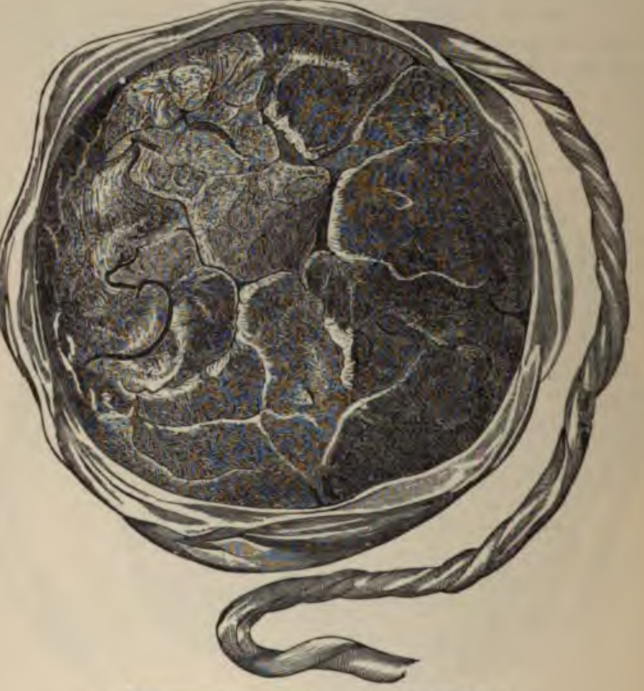


The internal or fœtal surface of the placenta.

Utero-placental Circulation. The most comprehensive explanation of this difficult problem has been advanced by Bumm, whose conclusions may be summarized as follows: The decidua gives rise to numerous processes between which the chorionic villi penetrate. (Plates XIII. and XIV.) The arteries of the processes run in an irregular manner with many spiral turns, and as they approach the surface of a process become tuft-like, and losing their coats open freely into the intervillous spaces. The veins open at the bases of the processes and along the decidual margins of the intervillous spaces. The chorionic villi, therefore, hang more or less freely in a blood-filled sinus. Each decidual process, cotyledon, has its individual circulatory region, the blood pouring out from the sides of the process and re-entering the maternal circuit through the veins at its bottom.

The greater the distance from the decidual process, the slower becomes the blood-current, until a point is reached where absolute stasis occurs with resulting fibrin deposit. The circular sinus at the edge of the placenta receives the blood from the lowest processes, but, as it appears often interrupted, it can have but limited importance in carrying off the blood. The chorionic villi very rarely if ever penetrate into the mouths of the arteries, but they do enter the veins and often for a considerable distance. (Plate XIV.)

FIG. 71.

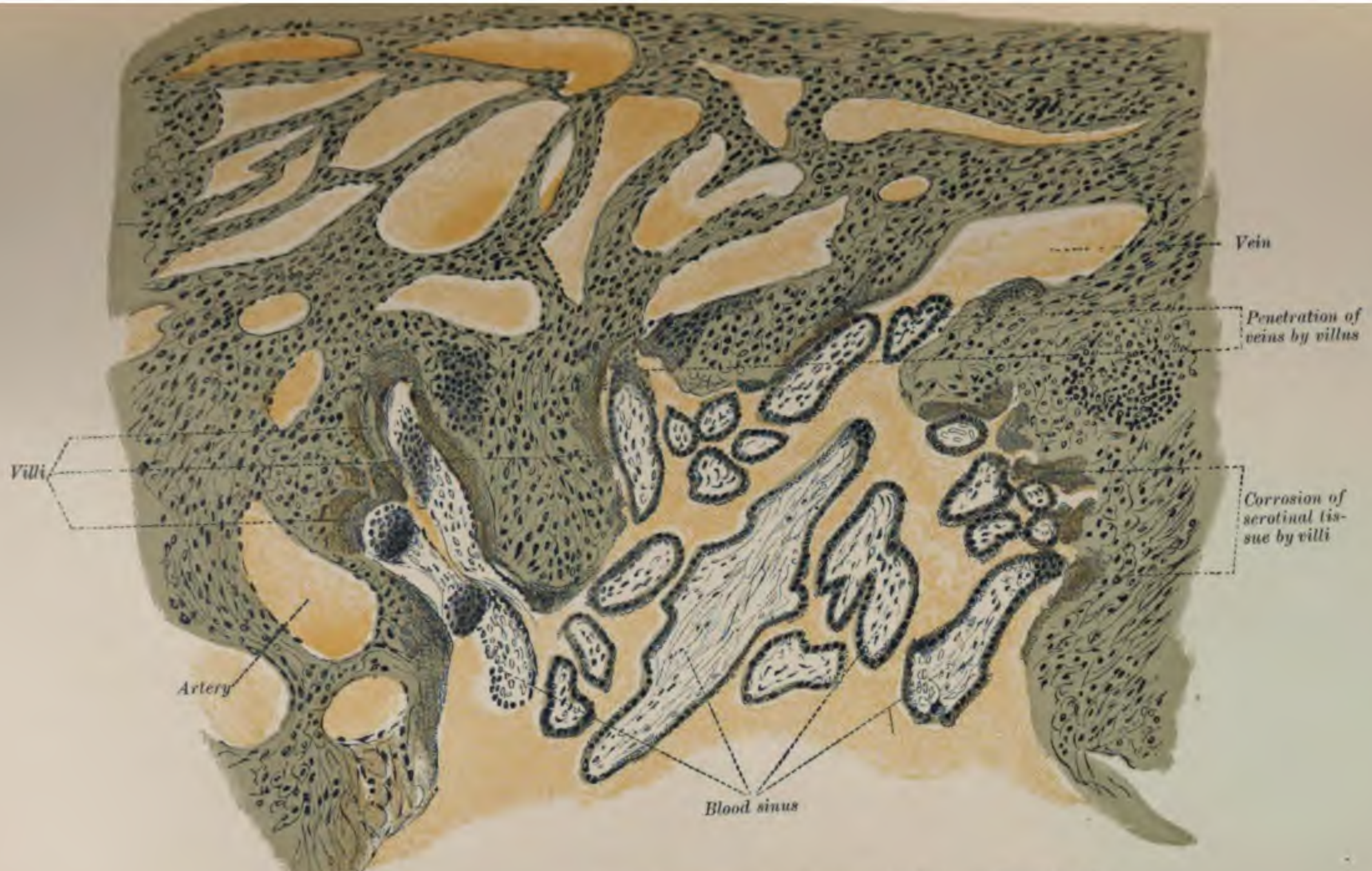


The external or uterine surface of the placenta.

The Embryonic and Fœtal Circulation. At a very early period of development the embryonic area presents, on surface view, a netted appearance, due to cord-like thickenings in the splanchnopleural mesoderm. Scattered among these cords are reddish-yellow patches, blood-islands or *islands of Pander,* the cells of which develop hæmoglobin, which gives rise to their color. This reticulated region is called the *area vasculosa,* and it is bounded by a large vessel, the *sinus terminalis.* (Fig. 79.) By a process of liquid vacuolation the mesodermal cords become hollowed out, and acquiring a lumen give rise to the primitive *bloodvessels.*

An extension of the vascular network takes place by the uniting and anastomosing of bud-like offshoots from the primitive vessels, which extend toward and finally penetrate the embryo, where they unite with the embryonic vessels.

Coincident with the formation of the extra-embryonic circulation, the


Vein
Penetration of veins by villus
Villi
Corrosion of serotinal tissue by villi
Artery
Blood sinus

Section through the Serotina, Ninth Week. (Bumm.)

embryonic heart is developed and begins to pulsate before connection with the vessels has been established.

As the result of splitting of the mesoderm and the folding off of the embryo, the splanchnopleural leaves are forced downward, and, approaching each other, unite in the ventral median line. Before this is accomplished a small cavity makes its appearance in the splanchnic mesoderm

FIG. 72.

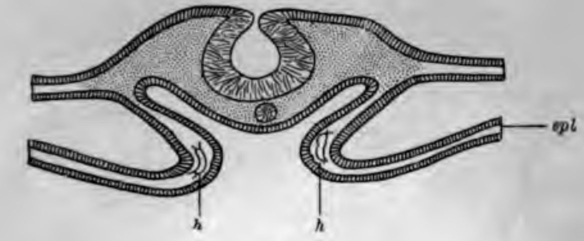


FIG. 73.

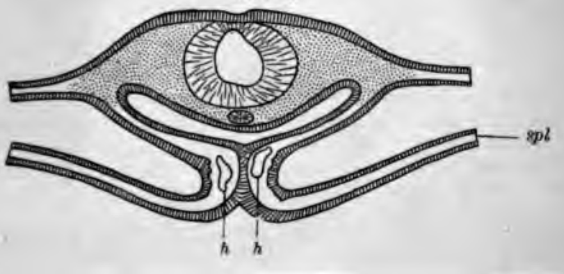
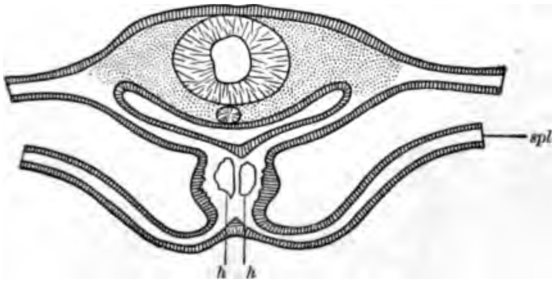


FIG. 74.

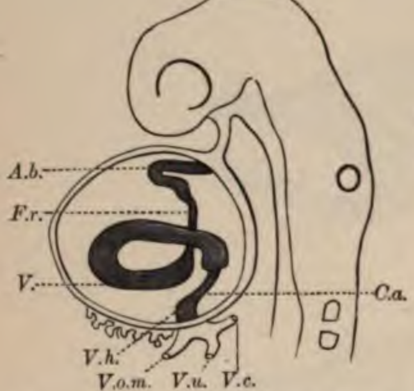


Schematic representation of the development of the heart (after O. HERTWIG).
h. Heart. *spl.* Splanchnopleure.

of either side in the cephalic region of the embryo. By the down-folding of the splanchnopleure these cavities come to lie ventrad to the future throat, and are gradually brought together, their walls fusing. (Figs. 72 to 74.) These cavities are the proton of the primitive *heart,* which is at the start a double tube. The middle wall of the heart-tube soon disappears, a single cavity resulting. The mesodermal cells of the heart cavity undergo changes which give rise to the endothelial lining of the completed organ. At first the heart is attached to the surrounding tissues by a ventral and a dorsal mesocardium, but the former and a portion of the latter disappear, leaving the heart projecting freely into the cœlomic cavity. The upper end of the heart-tube then dilates into what will be the future *aortic bulb.*

In the further development of the heart the lengthening of the tube in a confined space causes it to assume an S-shaped bend to the right, that portion to the right and in front representing the future auricles, that to the left and behind the ventricles. (Figs. 75 and 76.)

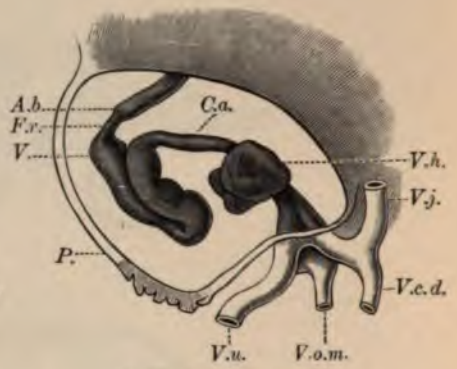
FIG. 75.



Endothelial heart of a human embryo (after HIS).

A.b. Bulbus aortæ. *F.r.* Fretum Halleri. *V.* Ventricle. *V.h.* Auricle. *V.o.m.* Omphalo-mesenteric vein. *V.u.* Umbilical vein. *V.c.* Vena cava. *C.a.* Auricular canal.

FIG. 76.

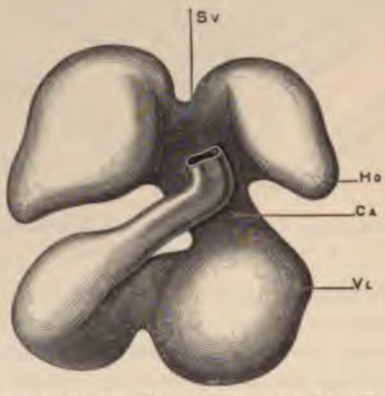


Endothelial heart (after HIS).

A.b. Bulbus aortæ. *F.r.* Fretum Halleri. *V.* Ventricle. *P.* Wall of pericardium. *V.u.* Umbilical vein. *V.o.m.* Omphalo-mesenteric vein. *V.c.d.* Cardinal vein. *Vj.* Jugular vein. *V.h.* Auricle. *C.a.* Auricular canal.

The auricular portions on either side expand and become somewhat constricted off from the ventricle, the opening between the two being the *auricular canal.* (Fig. 77.) A partition—the *septum superius*—then develops from above, and growing downward to the auricular canal con-

FIG. 77.

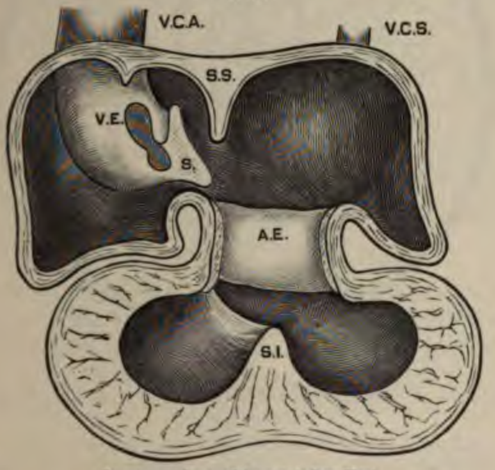


Endothelial heart of a human embryo (after HIS).

Sv. Sinus venosus. *Ho.* Auricle. *Ca.* Auricular canal. *Vl.* Ventricle.

verts the single auricle into right and left cavities. At a later stage the septum is perforated above, giving rise to the *foramen ovale*, an opening between the auricles which persists until some time after birth. The separation of the ventricles is first indicated by a groove on the exterior of the heart, a *septum inferius* developing from a corresponding point in the interior, and extending nearly upward to the auricular canal, a small foramen remaining open. (Fig. 78.) At the same time a division of the aortic bulb takes place, the septum extending downward to and fusing with the septum inferius. This division of the aortic bulb gives rise to two vascular channels, that to the left and in front becoming the pulmonary artery, while that to the right and behind is the permanent aorta, which has for its opening the interventricular foramen.

FIG. 78.



Inner surface of heart (after HIS).
V.C.S. Superior vena cava. S.S. Septum superius. V.E. Eustachian valve. S. Area interposita. A.E. Auricular canal. S.I. Septum inferius.

Coincident with the development of the heart and the extra-embryonic circulation, bloodvessels have been forming in various parts of the embryo, and with the uniting of these vascular channels a primitive circulation is soon established.

Primitive Embryonic Circulation. (Fig. 79.) The anterior end of the heart prolonged as the *truncus arteriosus* soon divides in the region of the fifth branchial arch into two primitive aortæ, which run forward and bend around on either side to the dorsum of the embryo, where they continue longitudinally to the caudal end. From the aortæ branches are given off, the chief of which, the *omphalo-mesenteric arteries*, carry most of the blood to the capillaries of the vascular area. The return current from the sinus terminalis is carried by the anterior and posterior *vitelline veins*, which unite near the middle of the embryo with the *omphalo-mesenteric veins* to form a large trunk, the *sinus venosus*, which enters the posterior end of the heart.

Secondary Embryonic Circulation. *Arteries.* With the development of the allantois and its union with the chorion, further changes in the circulation take place. The posterior portions of the two primitive aortæ fuse to form a single permanent *dorsal aorta,* from which branches, the *vitelline arteries,* are given off to the yolk-sac, and two terminal vessels—the *allantoic arteries*—which carry the blood from the placenta to the embryo.

FIG. 79.

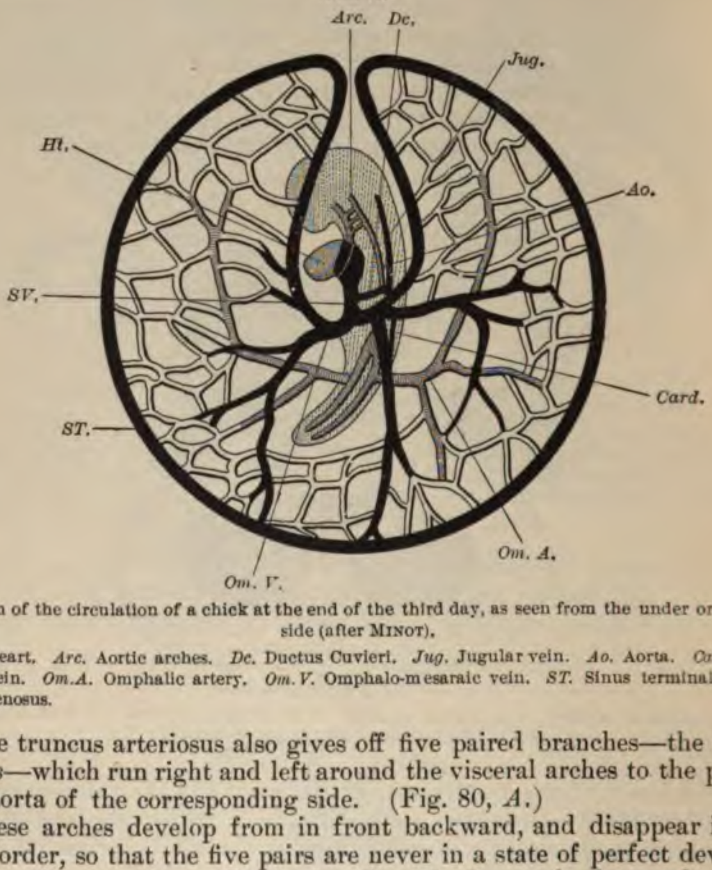


Diagram of the circulation of a chick at the end of the third day, as seen from the under or ventral side (after MINOT).

Ht. Heart. *Arc.* Aortic arches. *Dc.* Ductus Cuvieri. *Jug.* Jugular vein. *Ao.* Aorta. *Card.* Cardinal vein. *Om.A.* Omphalic artery. *Om.V.* Omphalo-mesaraic vein. *ST.* Sinus terminalis. *SV.* Sinus venosus.

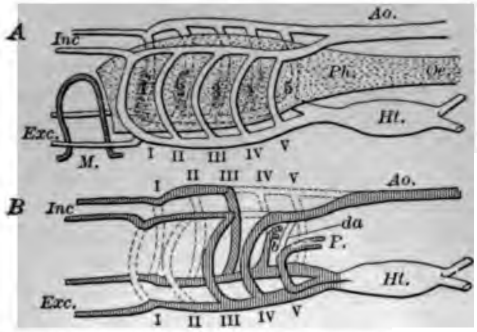
The truncus arteriosus also gives off five paired branches—the *aortic arches*—which run right and left around the visceral arches to the primitive aorta of the corresponding side. (Fig. 80, *A.*)

These arches develop from in front backward, and disappear in the same order, so that the five pairs are never in a state of perfect development at the same time. By the fourth week changes begin to take place in the arches which are indicative of the permanent adult vascular arrangement. The internal portions of the first arch on either side become the *external carotid arteries;* the third arch and the dorsal portions of the first and second arches give rise to the *internal carotid;* the ventral portions represent the *common carotids.*

The left fourth arch enlarges, becoming the *permanent aortic arch,* while the right fourth arch becomes distinctly smaller, loses its connection with the aorta, and dividing gives rise to the *vertebral artery* and its branch, the *subclavian,* of the right side. (Fig. 80, *B.*) The left fifth arch gives off the left *pulmonary artery,* which at first communicates with the dorsal aorta through the *ductus arteriosus* (*ductus Botalli*). The right fifth arch disappears above the origin of the pulmonary artery of that side.

The *iliac arteries* arise from the umbilical arteries—the proximal portions of the allantoic arteries—during the development of the posterior extremities. The remainder of the allantoic vessels become the *hypogastric arteries.*

FIG. 80.

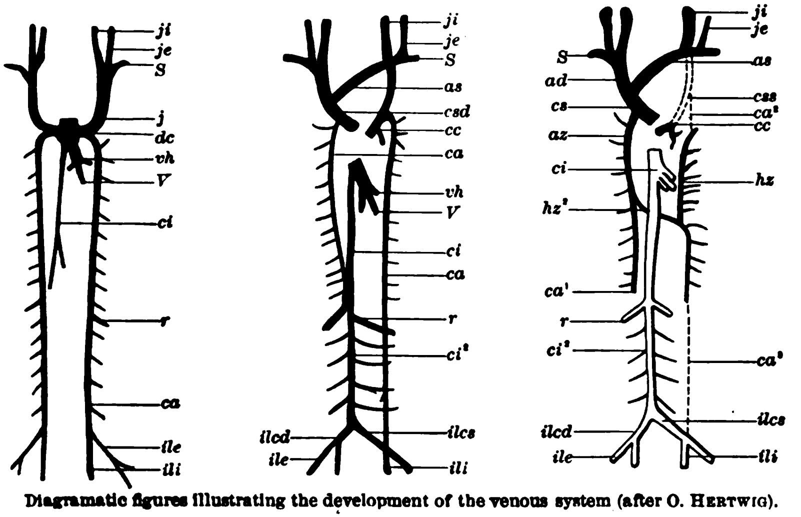


A. Diagram of pharynx of an amniote vertebrate. *B.* Diagram of gill arches as preserved in mammals (after MINOT).

The shaded portions are those which remain, the unshaded those which disappear. *Inc.* Internal carotid. *Ao.* Aorta. *Ph.* Pharynx. *Oe.* Œsophagus. *Ht.* Heart. *Exc.* External carotid. *M.* Mouth invagination. 1, 2, 3, 4, 5. Gill pouches (clefts). I, II, III, IV, V. Aortic arches. *da.* Ductus arteriosum. *P.* Pulmonary artery.

Veins. The blood is returned to the heart by four sets of vessels: the *jugular*, the *cardinal*, the *vitelline*, and the *umbilical* veins. The two jugulars receive the blood from the head, the two cardinals from the trunk, and both unite to form the *ducts of Cuvier*, which enter the heart

FIG. 81.



Diagramatic figures illustrating the development of the venous system (after O. HERTWIG).

dc. Ductus Cuvieri. *je, ji.* External and internal jugular veins. *S.* Subclavian vein. *vh.* Hepatic vein. *V.* Umbilical vein. *ci, ci^2.* Vena cava inferior. *ca, ca^1, ca^2, ca^3.* Cardinal vein. *ilcd.* Right and left common iliac veins. *ad, as.* Right and left brachio-cephalic veins. *cs.* Vena cava superior. *cc.* Coronary vein. *az.* Azygos vein. *hz, hz^2.* Hemiazygos vein. *ile.* External iliac. *ili.* Internal iliac. *r.* Renal vein.

by the *sinus venosus.* At a later period the right Cuvier's duct becomes the *superior vena cava ;* the left duct disappears.

The cardinals are in intimate relation with the Wolffian bodies, and on the resorption of the latter a middle part of the left cardinal disappears, its anterior portion becoming the *hemiazygos vein.* The right cardinal gives rise to the *azygos vein,* and the posterior portions of both cardinals to the *internal iliac veins.* (Fig. 81.)

The blood is returned to the yolk-sac by the two vitelline veins, which enter the embryo at the umbilicus, run cephalad along the splanchnopleural mesoderm beside the primitive gut, and empty into the *sinus venosus.*

In the hepatic region the vitellines are united by three transverse branches, and, after forming two vascular rings around the duodenal portion of the gut, break up into smaller vessels which enter the liver. These vessels are afferent, carrying the blood to the liver, where a capillary network is established; they later become (Fig. 82) branches of the portal vein. From the capillary network the blood is collected by efferent vessels which carry it to the heart; these vessels become the *hepatic veins.* At a later period the *portal vein* is developed from the two vascular rings, the right side of the upper ring and the left side of the lower ring disappearing, a single vessel remaining, which makes a spiral turn around the intestine.

FIG. 82.

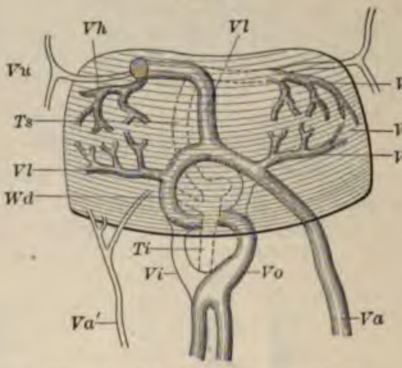


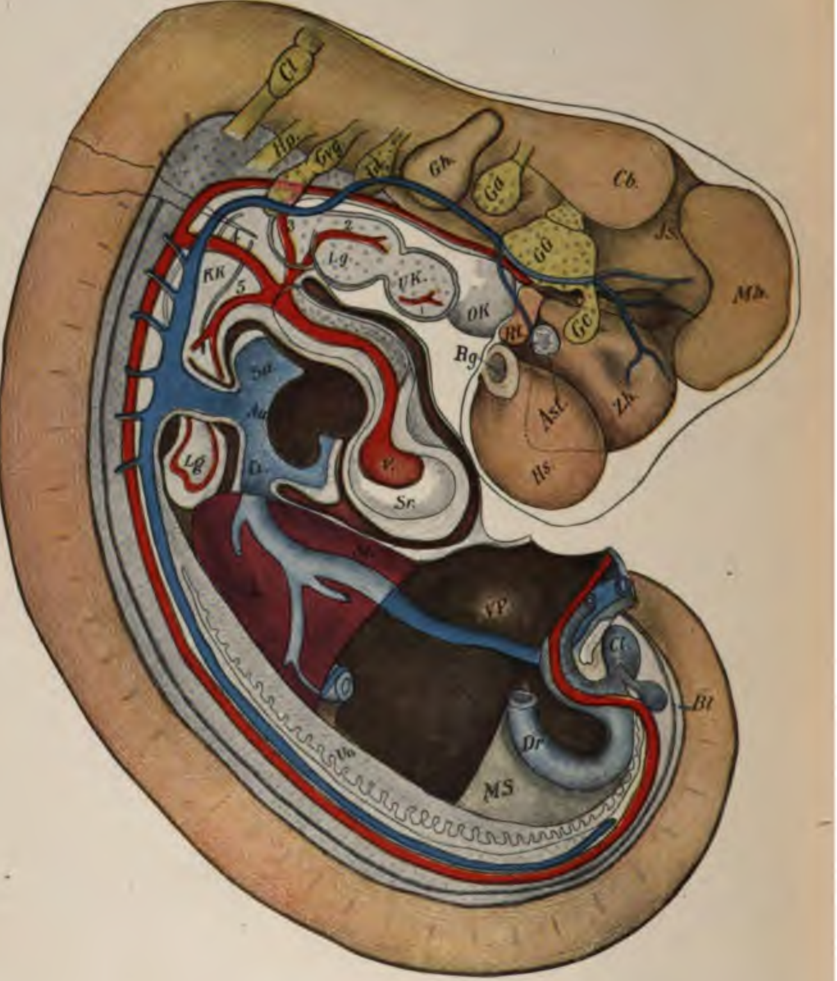
Diagram of the liver veins (after His).

Ts. Stomach. *Va'.* Right allantoic vein. *Vl.* Ductus venosus or vena Arantii. *Vh.* Efferent hepatic vessel. *Vl.* Afferent hepatic vessel. *Vo.* Portal vein. *Vi.* Vitelline vein. *W.* Liver. *Wd.* Bile duct. *Va.* Left allantoic vein. *Ti.* Intestine. *Vu.* The white vessels represent those which are aborted.

In the allantoic stalk the two umbilical veins fuse, forming a single vessel, which again separates within the embryo and, running in the somatopleure to the liver, empties into the duct of Cuvier. After a time the right umbilical vein dwindles and breaks up into several branches, some of which join the efferent hepatic veins as they leave the liver, while the remainder disappear. The left umbilical vein enlarges and joins the portal vein just as this vessel enters the liver.

When the vitelline and umbilical veins lose their direct connection with the heart—on account of the intercalation of the hepatic circu-

PLATE XV.



Diagramatic Representation of a Human Embryo estimated a
about Four Weeks old, showing Heart, Blood Vessels,
Brain and Abdominal Viscera. (Modified from His.)

Hs, hemispheres; Ast, optic stalk; Zh, 'tween brain; Mh, mid-brain; Js, isthmus of hind-brain Cb, cerebellum; Gc, ciliary ganglion; Rl, olfactory lobe; Rg, nasal pit; GG, Gasserian ganglion Ga, ganglion of auditory nerve; Gh, auditory vesicle; Gl, ganglion of glossopharyngeal nerve; Gvg ganglion of vagus nerve; Hp, hypoglossal nerve; Ci, ganglion of first cervical nerve; Ok, superio maxilla; UK, inferior maxilla; Lg, tongue; KK, larnyx; Sa, septum atrium; Sv, septum ventric lorum; C, internal carotid; Lg, lung; L, liver; St, septum transversum; Vp, vena portæ; U Wolffian bodies; Ms, mesentery; Dr, intestine; Cl, cloaca; Bl, kidney proton; V, ventricle; A auricle.

The dorsal aorta and internal carotid arteries are indicated in light red; the cardinal and jugular veins are in blue.

lation—the liver soon becomes unable to accommodate the increasing quantity of blood which passes through it, so that a communicating vessel is formed which connects the portal vein, just before it enters the liver, with the right hepatic vein just before it terminates in the sinus venosus. This is the *ductus venosus,* and through it the greater quantity of blood is carried directly to the heart without having to traverse the liver capillaries.

The *vena cava inferior* is developed as a small vessel from the ductus venosus, and runs through the liver caudad between the kidneys to terminate in the *iliac veins.*

The *pulmonary vein* at first empties into the left auricle by a single opening, but about the fourth month two or three mouths have developed and remain permanent.

The Blood. The primitive red cells are derived from the endothelial lining of the vessels and from the blood-islands. According to Minot, they are at first spherical, the nucleus is large, and they are surrounded by a layer of protoplasm. They multiply by indirect division. Before the formation of the lymph-glands little is known regarding the origin of the white blood-cells.

The Embryonic Circulation. In the primitive or vitelline circulation the blood is collected from the vascular area by the vitelline or omphalo-mesenteric veins, which empty into the sinus venosus. This also receives the blood from the systemic veins, and opens into the primitive cardiac auricle. From the ventricle the blood passes through the truncus arteriosus and the aortic arches to the primitive aortæ, whence it is returned through the vitelline or omphalo-mesenteric arteries to the vascular area, and to a limited extent to the body of the embryo.

Following the development of the allantois and the placenta the circulation becomes more complex. (Plate XV.)

The blood is carried from the placenta by the single umbilical vein to the under surface of the liver, where it divides into two streams, one proceeding through the ductus venosus to the inferior vena cava, and thence to the right auricle of the heart; the other, being joined by blood from the portal vein, passes through the capillaries of the liver, and so on through the hepatic veins to the inferior vena cava and the right cardiac auricle. From the right auricle the blood is directed by a fold —the *Eustachian valve*—through the *foramen ovale* to the left auricle. Here it meets with the current from the pulmonary veins, and is passed through the auricular-ventricular opening into the left ventricle, and thence to the aorta and the branches of the systemic vessels. From the head and upper extremities the blood is collected by the superior vena cava and, passing directly through the right auricle, enters the right ventricle, by which it is forced into the pulmonary artery. Just outside the lungs, however, the stream divides, a small portion only going to these organs, the greater part turning off through the ductus arteriosus to the aorta. From the aorta most of the blood passes through the hypogastric arteries back to the placenta, a small amount going to the lower portion of the embryonic body and extremities. (Plate XVI., *A.*)

Changes in Circulation at Birth. By the third or fourth day after birth the hypogastric arteries have dwindled and become obliterated; by the end of the first week the umbilical vein and the ductus venosus are closed; and by the end of the third week the ductus arteriosus has become impervious. The foramen ovale usually closes soon after birth, but it may remain patent as a diminutive aperture during the first year, or even throughout life. A persistent opening of the foramen results in an admixture of the venous and arterial blood in the auricles, which gives rise to a general blueness of the surface of the body, a condition known in the infant as *cyanosis neonatorum*, and in the adult as *morbus ceruleus.*

As the result of the obliteration of the vessels mentioned the blood from the cava, superior and inferior, passes from the right auricle to the right ventricle, from by the pulmonary artery to the lungs, from which it is returned by the pulmonary veins to the left auricle, and so on to the left ventricle, by which it is forced into the dorsal aorta and distributed to the trunk, head, and extremities. The adult circulation is thus established. (Plate XVI., *B.*)

The Central Nervous System. Before the closure of the cephalic end of the neural canal has taken place, the beginning of the future brain is indicated. (Fig. 83.)

FIG. 83.

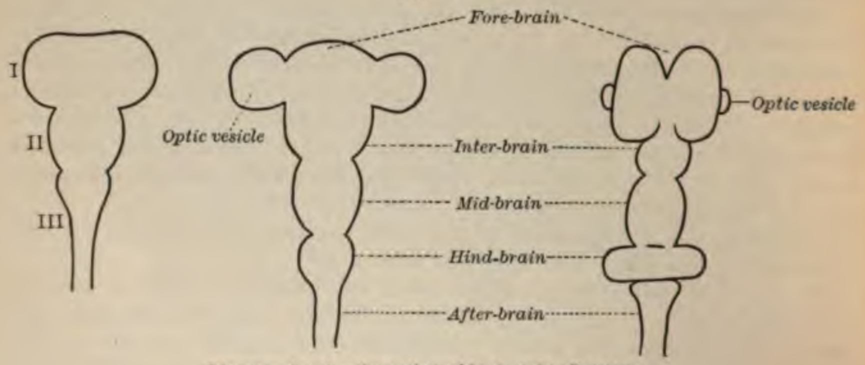
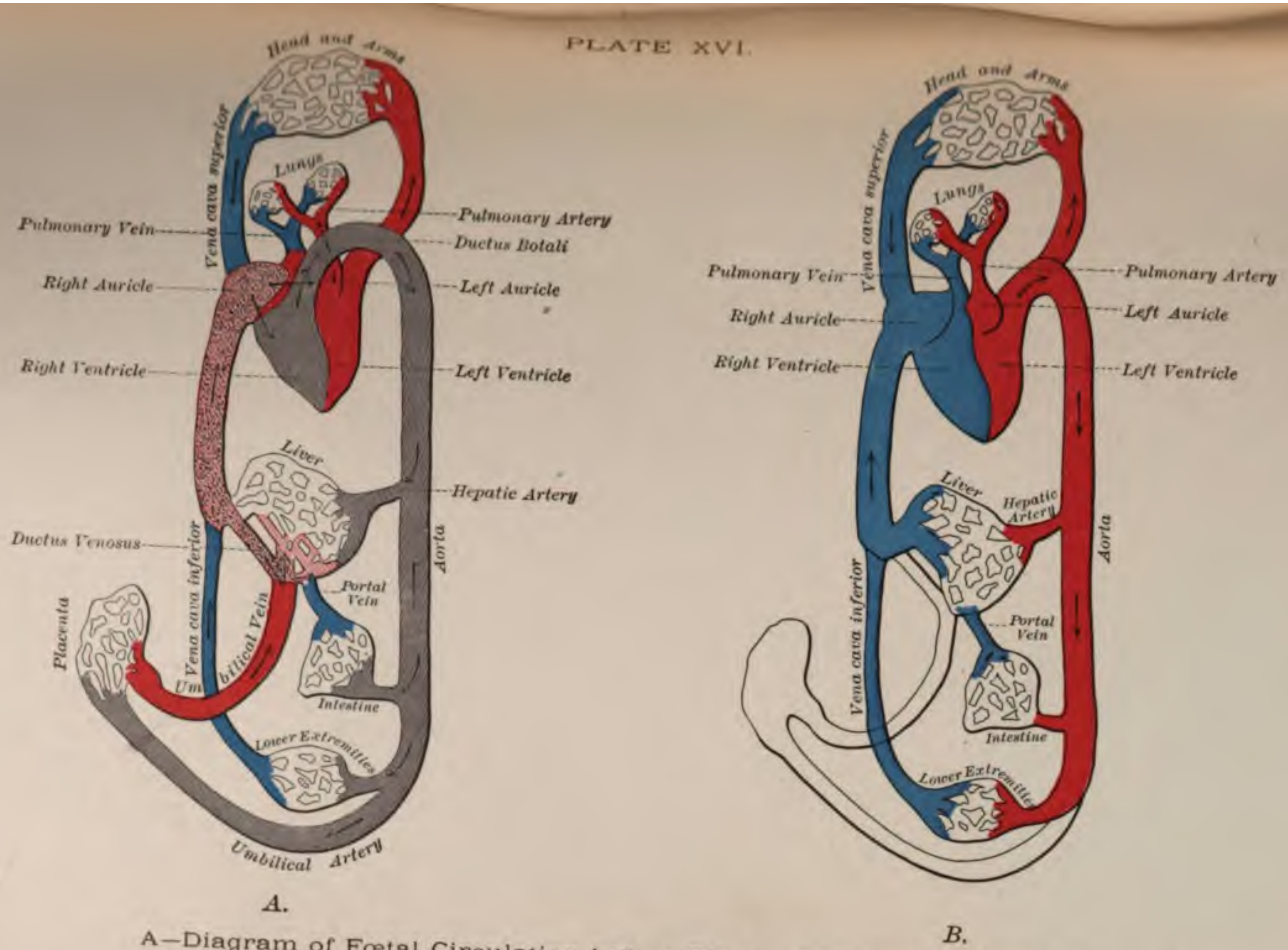


Diagram showing formation of brain (after BONNET).
I-III. Primary cerebral vesicles.

The anterior end of the medullary tube enlarges, and at two points its walls become constricted, giving rise to three communicating cavities, the *primary cerebral vesicles*, known as the *fore-brain*, *mid-brain*, and *hind-brain.* At about the same time that the cerebral vesicles are forming, the cephalic portion of the neural tube becomes bent as the result of the unequal growth of the parts. (Fig. 84.) The first of the cerebral flexures—the *primary head-bend*—takes place in the region of the mid-brain, the fore-brain being forced ventrad so that it comes to lie at a right angle to the mid-brain, the latter being carried forward and upward to the top of the head. The second, or *neck-bend,* occurs at the union of the hind-brain and the spinal cord, the whole head being thereby thrown further forward and downward, so that the floors of the fore- and hind-brains become parallel. The third bend—the *varolian bend*—affects the hind-brain, and consists in a forward growth of this vesicle.

With the beginning expansion of the fore-brain two lateral outgrowths

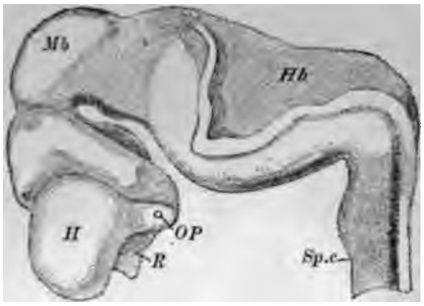
PLATE XVI.



A—Diagram of Fœtal Circulation before Birth. (Modified from Hasse.)
B—Diagram of Circulation after Birth.

—the *optic vesicles*—make their appearance. These soon become partially constricted off from the fore-brain, their narrow pedicles—the *optic stalks*—being the prota of the optic nerves. The dorsal wall of the fore-brain continues to grow forward and upward from the rest of the vesicle, and soon forms a fourth ventricle or *permanent fore-brain*, the proton of the *cerebral hemispheres*. (Fig. 85.) The original portion of fore-brain is now called the *inter-brain;* its cavity becomes the *third ventricle* of the adult brain, while the opening between it and the permanent fore-brain is the future *foramen of Monro.*

FIG. 84.



Brain of human embryo of five weeks, illustrating cerebral flexures (after HIS).

H. Hemisphere. *Mb.* Mid-brain. *Hb.* Hind-brain. *R.* Olfactory lobe. *OP.* Optic nerve. *Sp.c.* Spinal cord.

The second cerebral vesicle, mid-brain, develops more slowly than the other portions of the brain, which soon overgrow it, forcing it downward and backward. Its walls gradually thicken, while the cavity remains practically unchanged as the *aqueduct of Sylvius.* From the roof of the mid-brain the *corpora quadrigemina* are developed, and in connection with its floor the *crura cerebri.*

FIG. 85.

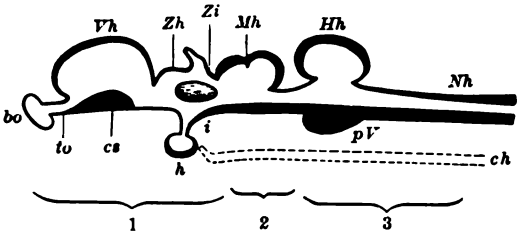


Diagram to illustrate the formation of the primitive brain (after BONNET).

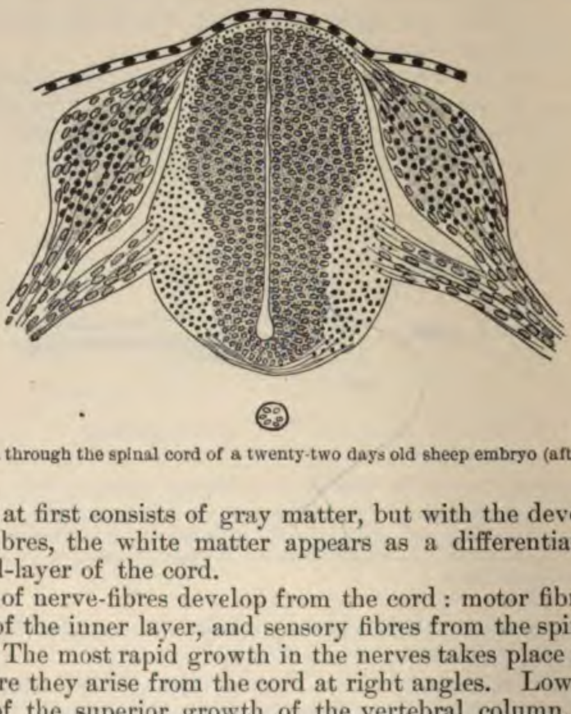
bo. Olfactory bulb. *Vh.* Secondary or permanent fore-brain. *Zh.* Inter-brain. *Zi.* Epiphyses. *i.* Infundibulum. *h.* Hypophysis. *Mh.* Mid-brain. *Hh* Hind brain. *Nh.* Medulla or after-brain. *pV.* Pons Varolii. *to.* Olfactory tract. *cs.* Corpus striatum. *ch.* Chorda dorsalis. 1, 2, 3 correspond to the three primitive cerebral vesicles.

The hind-brain, which at the time of the cerebral flexures is the longest part of the brain, soon becomes differentiated into two parts, an anterior, from the roof of which is developed the *cerebellum*, and from the apex of the floor (varolian bend) the *pons Varolii;* and a posterior portion, from the thickened floor of which, between the pons and the spinal cord, arises the *medulla oblongata*. The cavity of the hind-brain becomes the *fourth ventricle* of the adult brain. As the result of growth and local thickenings the various parts of the brain become differentiated from these primary structures.

The Spinal Cord. The neural canal is at first a simple tube with ectodermal walls. (Plate XII., *N*, Figs. 6, 8, and 9.) In the development of the spinal cord the sides of the tube become thickened, but the dorsal and ventral portions remain thin. The central lumen thus becomes narrowed. At a late period the sides are differentiated into the *anterior*, *lateral*, and *posterior columns* of the cord. The *anterior median fissure* is developed by the forward growth of the ventral portions of the cord, while the *posterior median fissure* represents the obliterated posterior end of the central canal.

Up to the fourth month the cord equals in length the vertebral column, and extends from the first cervical to the last caudal vertebra. (Plate XVII.) From this time on, however, the bony structures outgrow the cord, which appears shortened, and its lower end is drawn out into a fine filament—the *filum terminale*. By the sixth month the cord extends only to the sacral canal; at birth it is at the third lumbar vertebra, while a year later it is at the first lumbar vertebra, where it remains.

FIG. 86.

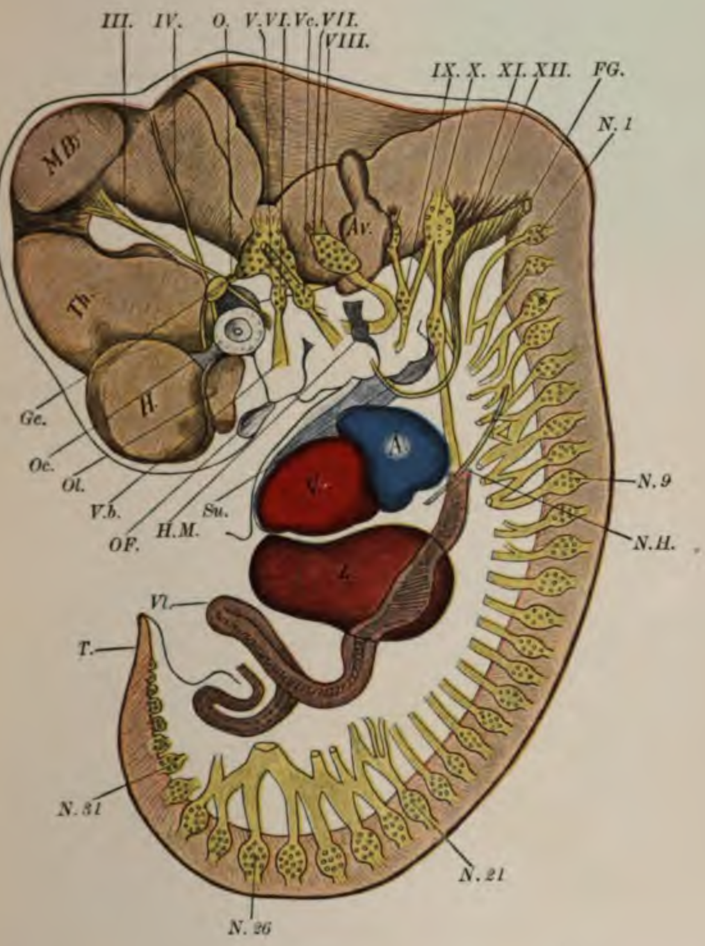


Transection through the spinal cord of a twenty-two days old sheep embryo (after BONNET).

The cord at first consists of gray matter, but with the development of the nerve-fibres, the white matter appears as a differentiation of the external cell-layer of the cord.

Two sets of nerve-fibres develop from the cord: motor fibres from the nerve-cells of the inner layer, and sensory fibres from the spinal ganglia. (Fig. 86.) The most rapid growth in the nerves takes place in the neck region, where they arise from the cord at right angles. Lower down, as the result of the superior growth of the vertebral column, the nerves gradually assume a vertical direction, and remain for some distance within the spinal canal before making their exit. The lower bundle of

PLATE XVII.



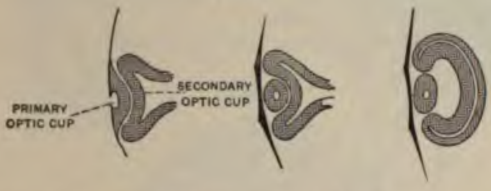
Diagramatic Representation of a Human Embryo estimated as Thirty-one Days old, showing Brain, Spinal Cord and Nerves. (Modified from His.)

H, cerebral hemispheres; Th, thalmencephalon; MB, mid-brain; Su, sinus precervicalis; H.M, hyomandibular cleft (external auditory meatus); OF, olfactory pit; V.b, maxillary branch of fifth nerve (trigeminal); Ol, olfactory lobe; Oc, optic cup; Gc, ciliary ganglion; III, third cranial nerve; IV, fourth cranial nerve; O, ophthalmic branch of fifth nerve; V, Gasserian ganglion; Vc, mandibular branch of fifth nerve; VII, ganglion of seventh nerve (facial); VIII, ganglion of eighth nerve (auditory); Av, auditory vesicle; IX, ninth nerve (glossopharyngeal); X, ganglion of root of tenth nerve (pneumogastric); XI, roots of eleventh nerve (spinal accessory); XII, roots of twelfth nerve (hypoglossal); FG, Froriep's ganglion; N.1, ganglion of first cervical nerve; N.9, ganglion of first thoracic nerve; N.H, phrenic nerve; N.21, ganglion of first lumbar nerve; N.26, ganglion of first sacral nerve; N.31, ganglion of first coccygeal nerve; T, tail; Vl, vitelline loop of intestine; L, liver; V, ventricle; A, auricle.

nerves surrounding the filum terminale thus presents a brush-like appearance; this has given rise to the name *cauda equina*.

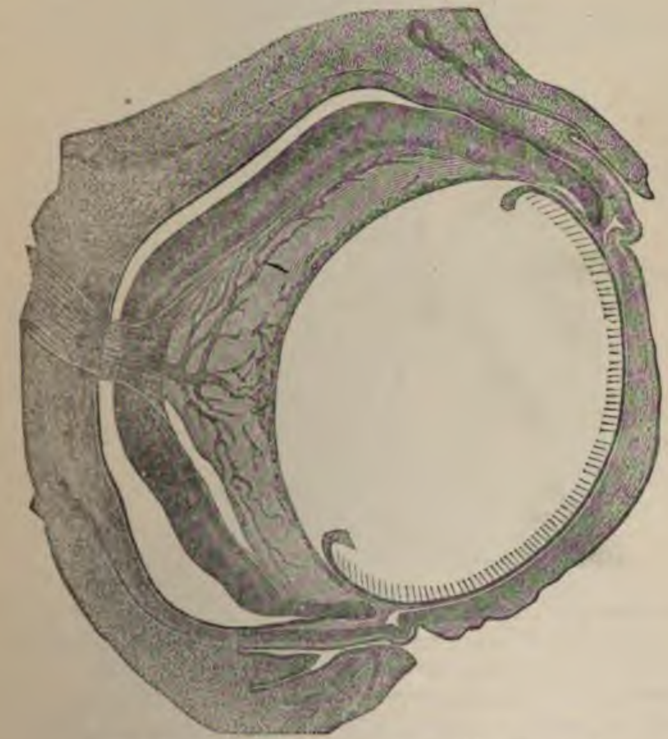
Organs of Special Sense. *The Eye.* The development of the optic vesicles as outgrowths of the fore-brain has already been described (see *Fig. 83*). When the vesicles reach the ectoderm a close attachment is formed between the two, and the walls of each increase in thickness at the point of contact. The ectoderm then becomes invaginated, forming the *primary optic cup*, the invagination continuing until a vesicle has become constricted off the proton of the *lens*. (Fig. 87.) In front of the lens-sac the edges of the ectoderm unite and, together with the meso-

FIG. 87.



Diagrams illustrating the formation of the optic cups and lens. (KÖLLIKER after REMAK.)

FIG. 88.



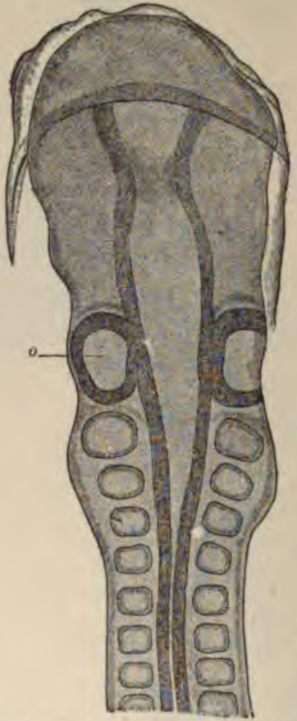
Section through the eye of a calf embryo. (After KÖLLIKER.)

derm, which has grown in between the lens and the ectoderm, form the proton of the *cornea*. (Fig. 87.) As the result of the invagination of the ectoderm, the wall of the optic vesicle is also pushed inward, forming a *secondary optic cup*, the doubled-in wall of which unites with the posterior wall of the optic vesicle to form the *retina*, the posterior layer of the wall furnishing the future *pigmented layer*.

The space between the retina and the lens develops the *vitreous humor*, while by the splitting of the mesoderm between the lens and the ectoderm the *anterior chamber* of the eye is formed, and later becomes filled with *aqueous humor*.

The tissues about the optic vesicle thicken into a capsule which ultimately becomes the *sclera* and the *choroid*. The opening of the secondary optic cup is filled by the lens, the edges of the cup giving rise to the *iris*, while the central aperture becomes the *pupil*.

FIG. 89.



Embryo of second day, showing otic pit (*o*). (After KÖLLIKER.)

The doubling in of the optic vesicle extends also to the stalk, along the ventral side of which a groove is formed, the *choroidal fissure*. This fissure closes about the seventh week by the fusing of its lips, but before this has taken place, an artery—the *arteria centralis retinæ*—has made its way along the groove, penetrated the vitreous humor, and sent off branches to the lens. The anterior portion of the artery becomes obliterated during the last month of fœtal life. The optic stalk is after a time converted into a solid rod, which acquires nerve-fibres from both the brain and the retina, and becomes the *optic nerve.*

FIG. 90.

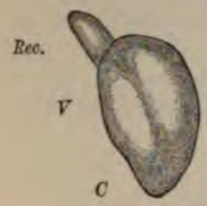


FIG. 91.

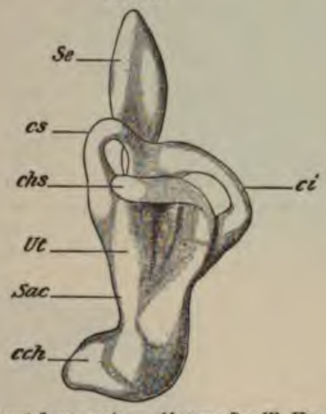
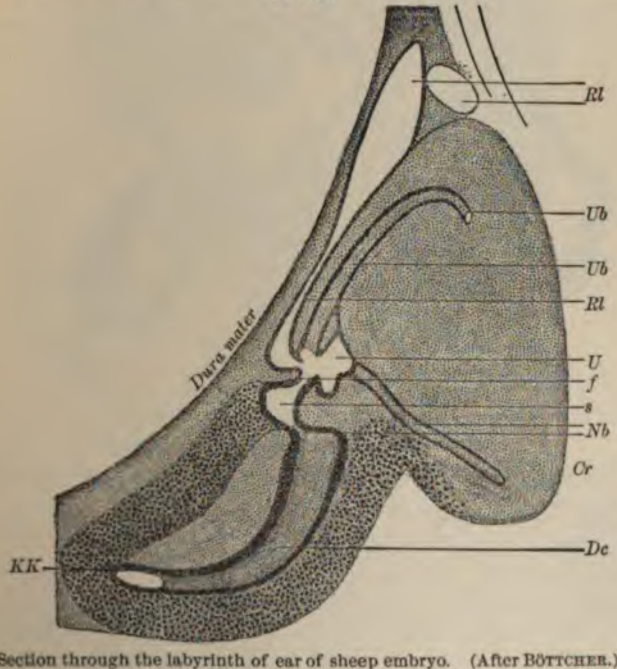


FIG. 90.—Left otocyst of a human embryo of about four weeks. (MINOT after W. HIS, JR.) *Rec.* Recessus vestibuli. *V.* Vestibular region. *C.* Cochlea region.

FIG. 91.—Left otocyst of a human embryo of about five weeks. (MINOT after W. HIS, JR.) *Se.* Saccus endolymphaticus. *cs.* Upper. *ci.* Lower. *chs.* Horizontal semicircular canal. *Ut.* Utriculus. *Sac.* Sacculus. *cch.* Cochlea.

FIG. 92.



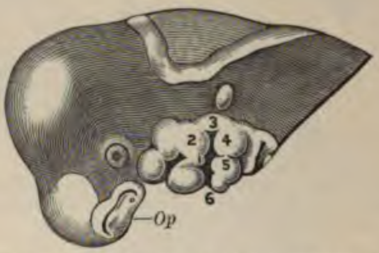
Section through the labyrinth of ear of sheep embryo. (After BÖTTCHER.)
Rl. Recessus labyrinthi: vertical and horizontal canals *U.* Utriculus. *s.* Sacculus. *Cr.* Canalis reuniens. *Dc.* Ductus cochlearis. *KK.* Cartilage.

The eyelids arise early as upper and lower folds of integument in front of the eye. The edges of the lids grow toward each other, meet and fuse, but again become separated shortly before birth.

The Ear. The development of the ear differs from that of the eye in that it is an ectodermal structure entirely separated from the brain.

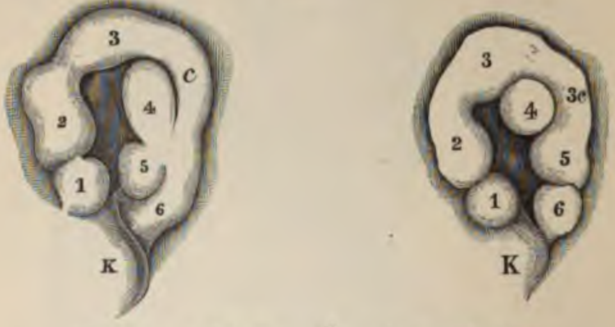
Internal Ear. The first indication of the ear appears about the fifteenth day as a thickening of the ectoderm just above the first gill-cleft. (Fig. 89.) By invagination of this thickened patch a sac is formed, the *auditory vesicle* or *otocyst*, which grows inward and becomes entirely separated from the ectoderm. At first the otocyst is spherical in form, but it soon becomes pear-shaped (Fig. 90) as the result of the development of a projection, the *recessus labyrinthi*, from its dorsal side. By the sixth week the otocyst has been converted by a fold into two portions—a dorsal part—the *utriculus*, from which three projections arise, the prota of the *semicircular canals* (Fig. 91), and a ventral part, the *sacculus*, from the anterior end of which the *cochlea* is developed.

FIG. 93.



Development of external ear. (After HIS.) The figures refer to the auditory tubercles.

FIG. 94.



Development of the human external ear. (After HIS.)
1. Tragus. 2, 3, *c*. Helix. 4. Anthelix. 5. Antitragus. 6. Tenia lobularis.

The lower proximal portion of the recessus labyrinthi is also converted into two tubes, which open into the sacculus and the utriculus respectively. (Fig. 92.) The complicated specialized portions of the internal ear arise as differentiations of the ectodermal lining of the structures.

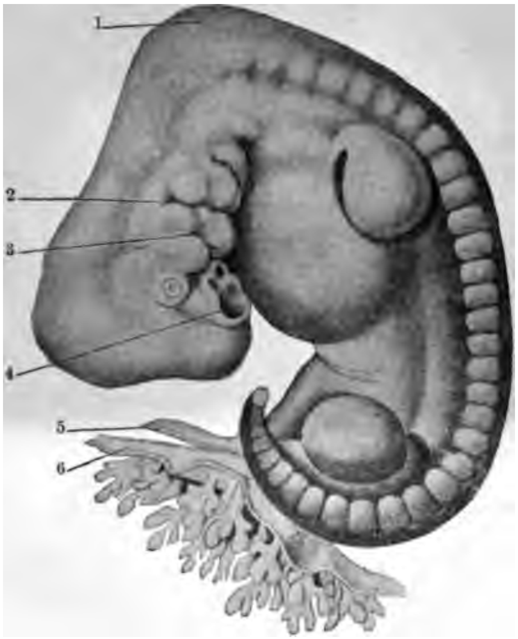
Middle Ear. The *tympanum* is developed from the membrane closing the first gill-cleft (*hyomandibular pouch*); the part within giving rise to the *Eustachian* tube and the *tympanic cavity*, which are lined by entoderm, the part without, to the external auditory meatus, being lined by ectoderm.

External Ear. This is developed from six auditory tubercles which

appear about the external meatus, two from the posterior edge of the first branchial arch, one intermediate, and three behind the first gill-cleft. (Fig. 93.) The first tubercle becomes the *tragus*, the second and intermediate fuse to form the *helix*, the fourth gives rise to the *anthelix*, the fifth to the *antitragus*, and the sixth to the *lobe*. (Fig. 94.) Very little is known regarding the development of the tactile sense; the other two organs of special sense will be described elsewhere.

The Alimentary Tract. From the three portions of the primitive enteron already mentioned are developed the pharynx, œsophagus, stomach, and intestines, and in connection with them the lungs, liver, and other thoracic and abdominal organs.

FIG. 95.



Embryo of four weeks. (HIS.)

1. Cervical spine. 2. Gills (aural opening). 3. Mouth fissure. 4. Nostrils. 5. Amnion. 6. Chorion and villi.

The Mouth. In the development of the mesoderm a space, the proamnion (Fig. 59), is left in front of the head end of the embryo in which no mesoderm appears, the ectoderm and entoderm being closely united at this point. By the formation of the cephalic fold and the bending of the head, this point of union of the two layers, known as the *oral plate*, is carried downward to the ventral side of the head, and comes to lie at the anterior end of the fore-gut, occupying all that space between the fore-brain and the heart. The forward growth of both the fore-brain and the heart gives rise to a depression or pit between them, at the bottom of which lies the oral plate. (Plate XII., Fig. 7, *m*.) The sides of the depression are formed by a layer of somatopleure which extends from heart to head, and afterward gives rise to the cheeks.

By the rupture of the oral plate a direct communication between the pit or oral cavity and the fore-gut is established.

The Pharynx. The anterior portion of the fore-gut, which from the first is the widest part of the primitive enteron, still further dilates at its distal end, thus converting the tubular canal into a funnel-shaped cavity, the future pharynx. This portion of the primitive gut has no cœlomic cavity.

At the beginning of the third week the entoderm of the sides of the pharynx develops a series of four paired pouches, the *branchial, visceral,* or *gill-clefts* (Fig. 95), which grow outward to the ectoderm and unite with it. The anterior pair of gill-clefts appear at about the level of the mouth, and are followed by the other three pairs in regular order. Meanwhile the tissues from the three primary layers along the sides of the pharynx develop into five ridges between the clefts—the *branchial, visceral,* or *gill-arches,* which project quite freely from the surface both internally and externally. (Figs. 96 and 97.)

FIG. 96.

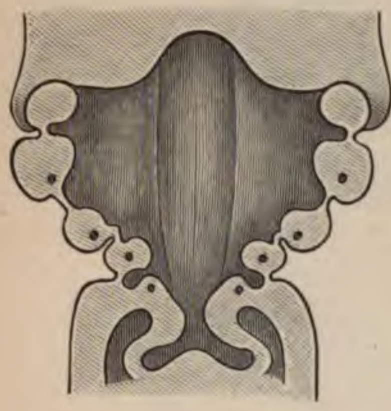


FIG. 97.

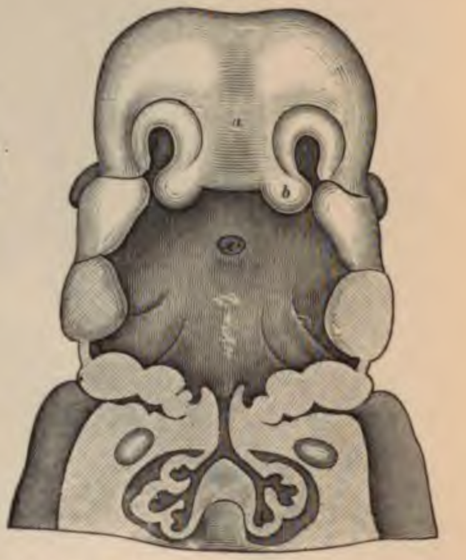


FIG. 96.—Frontal construction of the mouth and pharynx. (After HIS.)

FIG. 97.—Frontal construction of the mouth and pharynx, showing development of nose and lungs. (After HIS.)

The first visceral, or mandibular, arch, as it is afterward called, forms the lower boundary of the mouth, and is developed into the *inferior maxilla.* From this arch a process, called the *maxillary process,* is given off on either side, and these processes uniting at their distal ends form the upper boundary of the mouth. The second and third arches give rise to the *hyoid* and *thyro-hyoid bones;* the fourth and fifth arches have no particular significance, eventually disappearing.

From the first gill-cleft are developed the *Eustachian tube* and the *tympanic cavity;* from the second the *tonsils;* while the third and fourth clefts are concerned in the formation of the *thymus* and *thyroid glands.*

The Nose. At an early stage a thickening of a patch of ectoderm in contact with the fore-brain and lying cephalad to the mouth gives rise to the *olfactory plates.* (Fig. 93, *Op.*) By an upgrowth of the ectoderm and mesoderm around the plates they are converted into the *nasal pits,* the lower sides of which remain open as a groove communicating with the mouth cavity. A tongue of tissue—the *nasal process* (Fig. 97, *a*)—now develops from the anterior wall of the head, and as it grows downward toward the mouth sends out on either side a rounded protuberance, the *processus globulari* (Fig. 97, *b*), which unites with the maxillary process. The nasal grooves are thus converted into canals, the *posterior nasal passages,* leading from the pits to the mouth. Later the nasal pits become the narrow, slit-like apertures of the anterior nares. The *alæ nasi* arise from the growth of the lateral margins of the pits. The *Schneiderian membrane* is evolved from the epithelium of the olfactory plates, and at a later period is brought into relation with the olfactory lobes of the brain by means of ganglia which develop from its epithelium.

FIG. 98.

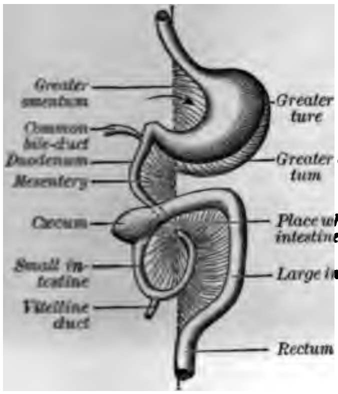
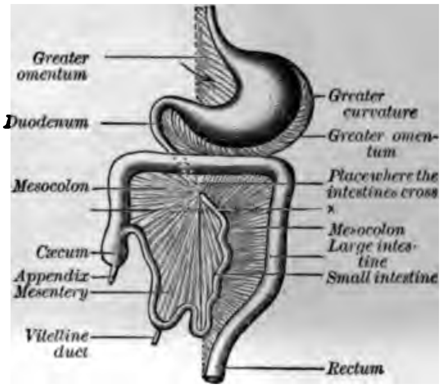


FIG. 99.



Diagrams illustrating the development of the stomach, intestine, omentum, and mesentery. (After O. HERTWIG.)

The Tongue. The anterior portion of the tongue arises as a small tubercle in the median line on the floor of the pharynx, between the ends of the first and second arches, the ends of the second and third arches fusing to form the proton of the back of the organ. The lingual epithelium is of ectodermal origin; the papillæ develop late, and from them the taste-bulbs.

The œsophagus is that part of the fore-gut lying between the pharynx and the stomach. During the fourth week, as the neck elongates the œsophagus is rapidly stretched out to a considerable length, but it still retains its cylindrical form.

The stomach appears during the fifth or sixth day as a slight dilatation of the primitive enteron between the œsophagus and the liver. (Figs. 102 and 103.) It soon shifts its position to below the liver. During the fifth week it becomes more pyriform in shape, and assumes a transverse position in the body, its left side coming to the front, while its right side is turned backward. During the change in position of the stomach its attachment to the dorsal body-wall becomes stretched out as a thin membrane—the *mesogastrium*—which, as the stomach rotates, forms a double fold, that part of the membrane along the greater curvature of the stomach giving rise to the *greater omentum*, while that from the smaller curvature becomes the *lesser omentum*. (Figs. 98 and 99.)

The *intestine* includes all of the alimentary canal between the stomach and the anus. At first it is a straight tube, but as the result of rapid growth it soon becomes coiled in order to accommodate its increasing length within the abdominal cavity. A duodenal loop (Fig. 100) is formed just below the stomach, and lower down a vitelline loop, which is in connection with the yolk-sac, appears. The lower portion of the intestinal canal enlarges and grows more rapidly than the upper part and forms the large intestine. The cæcum appears about the fifth week as a protrusion from the distal portion of the vitelline loop near the yolk-stalk, and from it the *vermiform appendix* develops as a long and slender outgrowth. (Fig. 99.) The posterior end of the intestine terminates in a wide dilatation—the *cloaca*—which forms the common receptacle for the excretions from intestines and bladder.

FIG. 100.

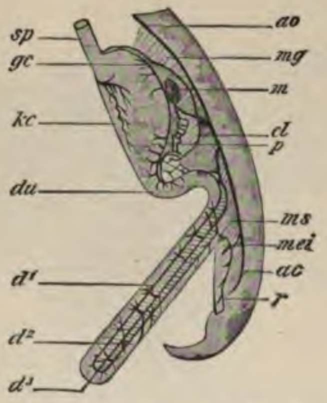


FIG. 101.

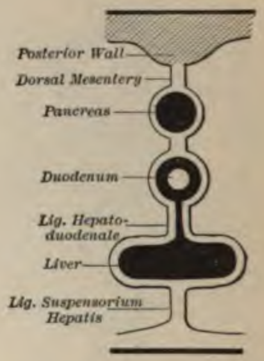


FIG. 100.—Schematic illustration of the intestinal canal in a human embryo of the sixth week. (After TOLDT.)

FIG. 101.—Diagram illustrating the origin of the liver. (After O. HERTWIG.)

sp. Œsophagus. *kc.* Lesser curvature. *gc.* Greater curvature. *du.* Duodenum. d^1. Proton of small intestine. d^2. Proton of large intestine. d^3. Vitelline duct. *mg.* Mesogastrium. *ms.* Mesenterium. *m.* Spleen. *p.* Pancreas. *cl.* Cœliaca. *ao.* Aorta. *mei.* Mesenterica inferior. *ac.* Aorta caudalis. *r.* Rectum.

As the intestine elongates and separates from its attachment to the body-wall, the mesoderm is drawn out as a thin membrane, which later becomes the *mesentery*. (Fig. 99.) About the fourth week an invagination of the ectoderm takes place on the ventral side of the embryo opposite to the terminal portion of the cloaca, by which the ectoderm is brought into contact with the entoderm, the two layers giving rise to the *anal plate* (Plate XII., Fig. 7, *a*), and the ultimate rupture of this plate forms a cloacal opening which afterward becomes the *anus*.

The *liver* arises about the fifteenth day as a hollow diverticulum from the ventral side of the fore-gut just below the heart (Fig. 101), and almost immediately gives off a second evagination. (Fig. 102.) The walls of these pouches become greatly thickened, and their distal ends are surrounded by a mass of yolk-cells which become separated off from the rest of the yolk. A network of solid cords is next developed in the cell-mass, and these, acquiring a lumen during the fourth week, form the proton of the *hepatic ducts*. The meshes of the network are filled with bloodvessels. The liver enlarges rapidly, so that at birth its weight in proportion to that of the whole body is twice as great as in the adult. The canal of the original diverticulum becomes the *common bile-duct* (*ductus communis choledochus*), and from this, before the end of the fifth week, a bud is given off to form the *gall-bladder*.

The *pancreas* is developed during the fourth week as a diverticulum from the dorsal side of the duodenum nearly opposite the liver evagination, and grows into the mesogastrium where it gives off branching buds. The duct opening into the intestine at first lies in front of the bile-duct, but subsequently runs parallel to the latter, and the two open into the duodenum by a common orifice. (Fig. 102.)

Fig. 102.

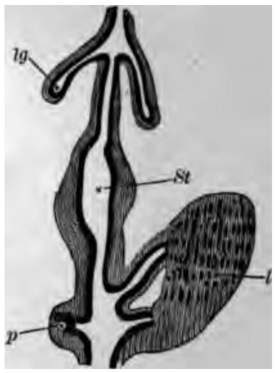


Diagram of liver proton. (After Götte.)
lg. Lung. *St.* Stomach. *l.* Liver. *p.* Pancreas.

During the second week the *pulmonary organs* appear as two diverticula from the ventral side of the œsophagus just above and behind the auricle of the heart. (Figs. 97 and 103.) At this point the œsophageal tube is compressed laterally, and still further caudad becomes pear-shaped, then triangular, and finally separates into three divisions or tubes, the posterior tube forming the œsophagus proper, and the two lateral tubes the *bronchi*. The slit-like aperture through which the pulmonary diverticula open into the œsophagus just behind the fourth branchial arch is the future *glottis*, while the part immediately caudad represents the *trachea*. By the repeated branching of the latter the bronchioles and the alveoli appear.

The *larynx* arises as a widening of the upper portion of the trachea; and the *epiglottis* is developed from a small tubercle situated posteriorly to the tubercle for the tongue.

The lungs project conspicuously into the body-cavity, and, growing dorsad and caudad, push the peritoneum before them in the form of pouches which become the *pleural sacs*. The epithelium lining the pulmonary tract is derived from the entoderm, while the spaces between the bronchioles are filled with bloodvessels and tissue of mesodermal origin.

The Urogenital System. The first indication of the urinary organs appears about the fifteenth day as a pair of rod-like cell masses, probably of ectodermal origin, lying in the tissues, one on either side, between the myotomes and the somato-splanchnopleural junction, and extending from the region of the heart caudad. Each rod acquires a lumen and becomes the *Wolffian duct*. (Plate XII., Figs. 8, 9, *un*.) The caudal ends of the ducts are at first blind, but by rapid lengthening they soon reach to the posterior end of the intestine and open into the *cloaca*. (Fig. 104.) About the eighteenth day a longitudinal ridge appears along the dorsal wall of the body-cavity on either side of the basal attachment of the mesentery. These ridges project into the body-cavity and constitute the *Wolffian bodies*.

Within the ridge on the mesenteric side a series of cord-like thickenings develop and, acquiring a central canal, grow toward the Wolffian duct

FIG. 103.

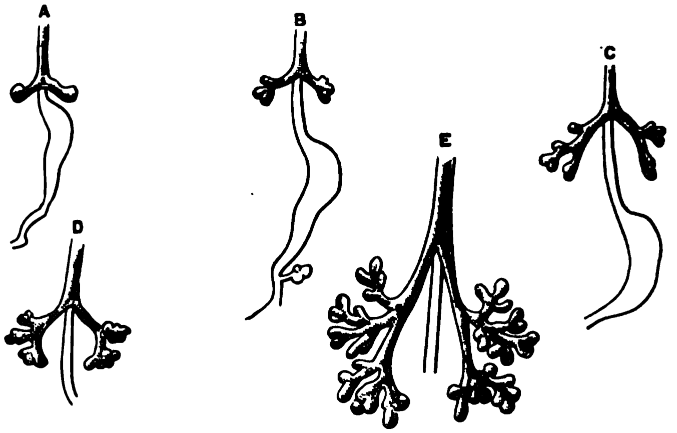


Diagram showing the development of the lungs. (After HIS.)

FIG. 104.

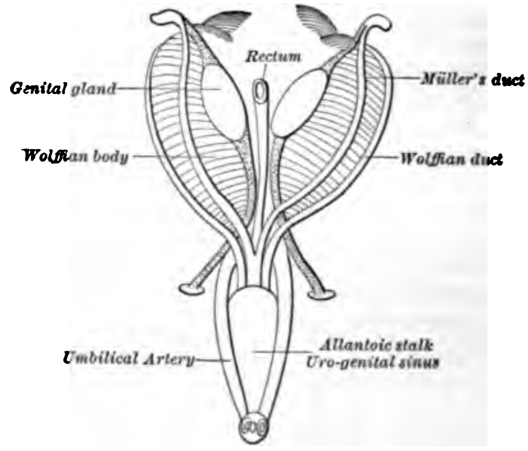


Diagram of urogenital apparatus. (After BONNET).

FIG. 105.

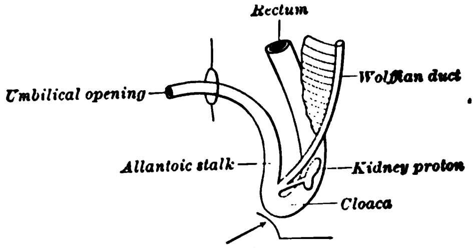


Diagram of kidney proton and cloacal region. (After BONNET.)

into which they open as the *Wolffian tubules*. The distal closed ends of the tubules become dilated and then invaginate to form the *Malpighian bodies;* the *glomeruli* arise from the branches of the aorta which penetrate the Wolffian body at an early period. The veins, as has been mentioned, empty into the cardinal vein. Early in the fourth week an evagination appears on the dorsal side of the Wolffian duct just above the termination of the latter in the cloaca. (Fig. 105.) The distal end of this diverticulum grows rapidly cephalad between the Wolffian body and the vertebræ until it reaches the head-end of the former, where it dilates and covers the Wolffian body dorsally, forming the proton of the *kidney*. The long canal opening into the Wolffian duct represents the future *ureter*, and its upper end, which becomes dilated, the *renal pelvis*. From the dilated part of the renal evagination branches are given off to form the *urinary tubules*, from the blind ends of which the *Malpighian bodies* arise. The kidneys are definitely formed by the end of the eighth week, at which time the resorption of the Wolffian bodies begins, all but the cephalic ends of the latter disappearing. The opening of the ureter is subsequently shifted from the Wolffian duct to the urogenital sinus. (Fig. 106.)

FIG. 106.

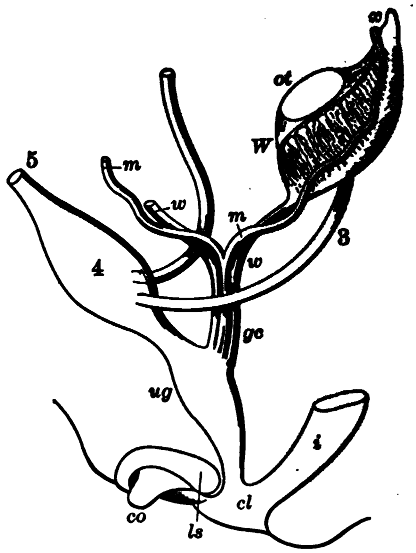


Diagram of urogenital and sexual organs. (After GRAY.)

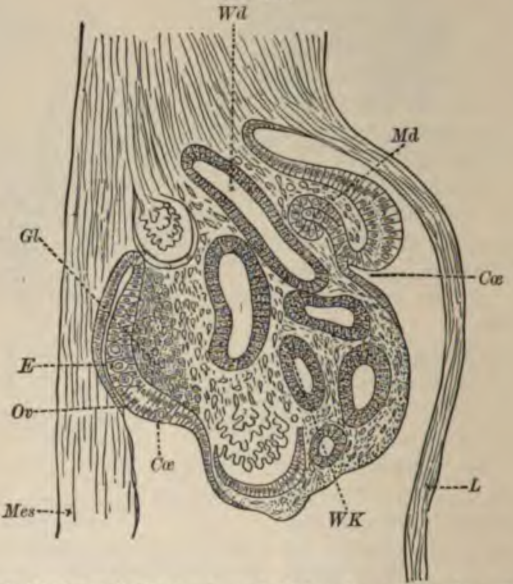
The parts are shown chiefly in profile, but the Müllerian and Wolffian ducts are seen from the front. 3. Ureter. 4. Urinary bladder. 5. Urachus. *ot*. The mass of blastema from which ovary or testicle is afterward formed. *W*. Left Wolffian body. *x*. Part at the apex from which the coni vasculosi are afterward developed. *w*, *w*. Right and left Wolffian ducts. *m*, *m*. Right and left Müllerian ducts uniting together and with the Wolffian ducts in *gc*, the genital cord. *ug*. Sinus urogenitalis. *i*. Lower part of the intestine. *cl*. Common opening of the intestine and urogenital sinus. *co*. Elevation which becomes clitoris or penis. *ls*. Ridge from which the labia majora or scrotum are formed.

The *suprarenal capsules* are developed partly from the mesoderm and partly from branches arising from spinal sympathetic ganglia. That part of the allantois contained within the abdominal cavity and lying between the cloaca and the umbilicus gives rise during the second month to the urinary *bladder*. The proximal portion of the allantois dilates into a spindle-shaped vesicle, the upper part of which dwindles and finally becomes a cord—the *urachus*. The bladder is lined by entoderm and its walls are formed from the mesoderm. At the close of the fourth week there appears a band of thickened peritoneum (*mesothelium*) along the external lateral border of each Wolffian body, extending caudad to the cloaca. During the fifth week each band acquires a lumen which opens above into the body-cavity and below into the cloaca. These are the *Müllerian ducts*, the prota of the female internal organs of generation.

At an early period there appears on either side along the dorsal wall of the cœlom between the Wolffian body and the mesentery a small ridge which extends nearly the whole length of the abdominal cavity. (Fig. 107.) This ridge is the *genital fold*, and is formed by the thickening of the peritoneal epithelium, which at this point is called the *germinal epithelium*, because from it are developed the egg-cells of the female and the spermatozoa of the male. The middle portion of the ridge is the proton of the *sexual gland—ovary* or *testis*. At a later stage the caudal ends of the genital ridge draw toward the median line and unite to form the *genital cord*. The differentiation of the sex, which can be determined microscopically as early as the fifth week, depends upon the changes which take place in the sexual gland.

In the *male* the sexual gland becomes the *testis*. A network of epithelial cords is first formed, and embedded in these are the primitive sperm cells. The cords acquire a lumen and become the prota of the *seminiferous tubules*. They connect with the anterior tubules of the Wolffian body which grow into the testis during the fourth month, and anastomosing in various directions form the *rete testis*. (Fig. 108, *A*.) The outer tubules of the Wolffian body serve as communicating channels with the Wolffian duct—*vasa efferentia*—the duct itself in its upper portion becoming the *epididymis*, and below the *vas deferens*. In the male the middle portion of the Müllerian duct disappears, the upper end in contact with the testis giving rise to the *hydatid of Morgagni;* its lower part buried in the genital cord forms the so-called *uterus masculinus*.

FIG. 107.



Wolffian body, genital fold, and Müllerian duct of chick embryo, fourth day. (After WALDEYER.) *Wd.* Wolffian duct. *Md.* Müller's duct. *E.* Genital epithelium. *Ov.* Primitive ova. *Gl.* Glomerulus. *Mes.* Mesentery. *Cæ.* Cœlom.

In the *female* the sexual gland becomes the *ovary*. The sexual cords from the genital mesothelium, or, as they are called here, the cords of

Pflüger, contain the primitive ova which become surrounded and separated from one another by smaller cells, forming an epithelial boundary or follicle around each ovum. The tubules from the Wolffian body grow into the ovary in the same manner as into the testis, giving rise to the *parovarium* or *organ of Rosenmüller*. (Fig. 108, *B*.) The anterior portion of the Wolffian duct persists as the longitudinal duct of the parovarium; its caudal end disappears, or remains as the duct of *Gärtner*.

FIG. 108.

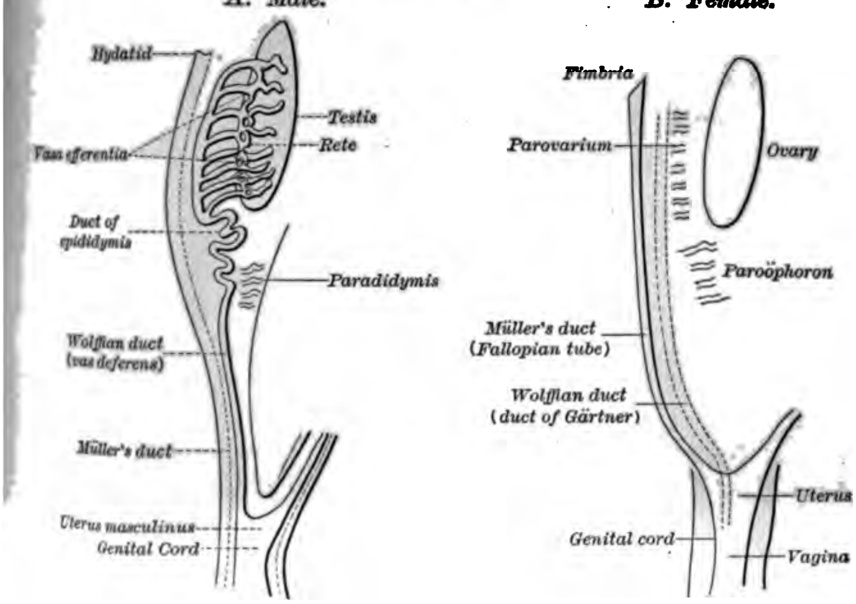


Diagram to illustrate the homologies of the sexual apparatus. (After MINOT.)

The upper portion of the Müllerian duct above the genital cord gives rise to the *Fallopian tubes* or *oviducts*. At first these tubes run parallel with the body, but later they assume an oblique and finally a transverse position in the pelvic cavity, as in the adult. The genital folds as the result of superior growth of the other parts of the fœtus are also carried across the body-cavity, and thinning out give rise to the *ligamenta lata* or *broad ligaments*.

The lower portions of the Müllerian ducts included in the genital cord fuse in their lower middle portions to form a single tube—the *utero-vaginal canal*, the upper part of which is differentiated during the fourth month into the *uterine fundus* and *body*, the *cervix uteri* appearing some time during the fifth month. The lower part of the canal dilates and becomes the *vagina*.

About the fourth week a septum develops and divides the cloaca into two cavities, an anterior, the *urogenital sinus* (Fig. 106), which includes the openings of the allantois and the Müllerian ducts, and a posterior, anal opening. The further growth of this dividing wall carries the two openings more and more apart, and ultimately appears as the *perineum*.

The External Genitals. The development of the external genitalia is the same in both sexes up to the ninth or tenth week. About the fifth week a small projection—the *genital tubercle*—is formed by the thickening of the anterior portion of the anal plate. This is the proton of the *clitoro-penis.* The tubercle later develops a head or glans, and a furrow—the *genital groove*—appears along its ventral side, running backward to the urogenital sinus. During the tenth week a slight elevation—the *genital labium*—arises on either side of the genital tubercle and extends

FIG. 109.

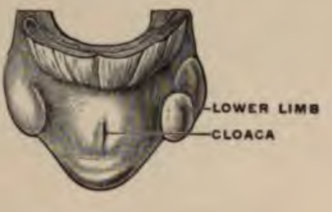


FIG. 110.

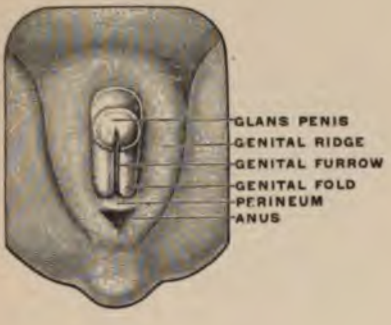


FIG. 111.

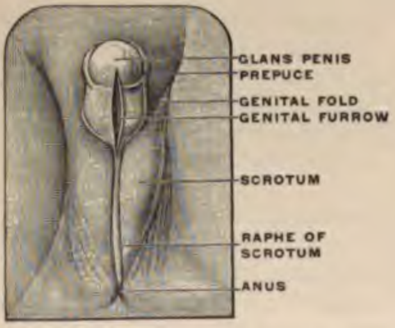


FIG. 112.

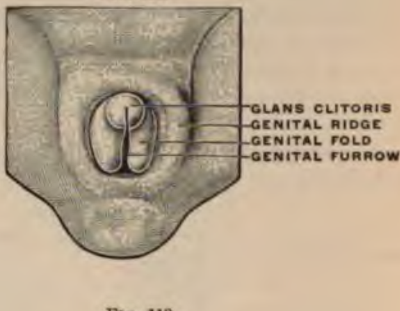


FIG. 113.

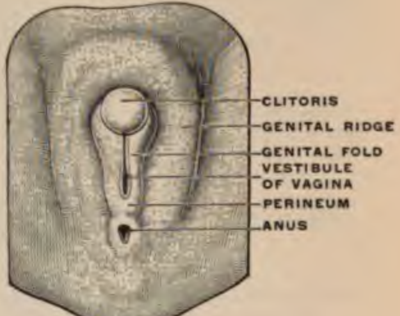
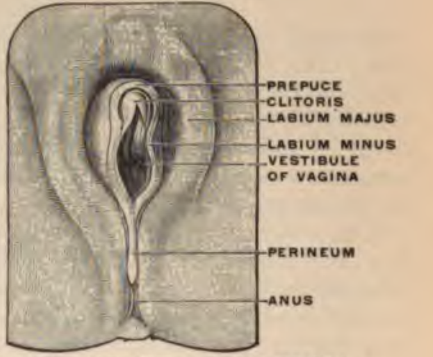


FIG. 114.



Six stages in the development of the external genitals. (After ECKER-ZIEGLER models.)

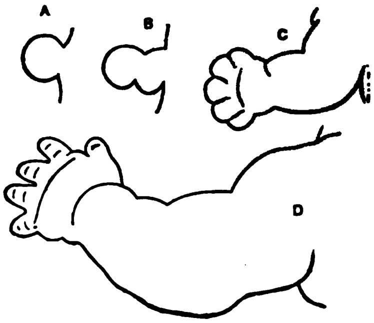
backward along the lateral margin of the urogenital sinus. Changes now take place which differentiate the male from the female organs.

In the *male* the genital tubercle elongates and becomes the *penis* (Figs. 109 to 111); and the furrow along its under surface is converted into a canal—the *urethra*—by the growth, apposition, and fusion of the sides of the groove. Their line of union is represented in the adult by the *raphe penis.* Toward the close of the fifth month the *prepuce* is developed as a fold of skin around the base of the glans. The *scrotum* arises during the fourth month by the meeting and fusion of the genital labia, which enlarge and grow downward between the root of the penis and the anus.

In the *female* the genital eminence remains small and becomes the *clitoris.* (Figs. 112 to 114.) The genital groove is closed in to form the *urethra,* while its side folds develop to form the *labia minora* or *nymphæ.* The genital labia give rise to the *labia majora,* the anterior extremities of which become the *mons veneris* or *mons pubis.*

The Skeleton. The osseous system of the embryo is relatively late in appearing, the bones arising either from a preceding cartilaginous stage or independently in membrane. The notochord, the earliest indication of the axial skeleton, is first surrounded by a membranous sheath, outside of which a cartilaginous tube is subsequently formed, and from this arise the bodies and processes of the vertebræ. Ossification takes place in each vertebra from three centres, one for each arch and one for the body, to which two more centres are added later for the epiphyses.

FIG. 115.



Development of the human anterior extremities. (ALLEN THOMSON, after HIS.) *A.* At four weeks. *B.* At five weeks. *C.* At seven weeks. *D.* At nine or ten weeks.

The *pelvis* appears as a bar of cartilage (*ilium*) on either side, articulating at the middle with the femur, and united at their ventral ends by connective tissue. The *ischium* and *pubis* arise ventrally from the acetabular region and uniting at the symphysis enclose a space, the *obturator foramen.* By the end of the third month ossification begins from three centres, one for each bone, but the union of the three to form the innominate bone is not completed until puberty.

The extremities (Fig. 115) arise during the third week as bud-like outgrowths from a lateral longitudinal ridge extending along the ventral ends of the muscle plates for nearly the whole length of the embryonic trunk.

EMBRYO AND FŒTUS AT DIFFERENT PERIODS OF DEVELOPMEN

First month—visceral arches and clefts readily distinguished. Spi canal closes. Buds of rudimentary extremities appear. Indication

FIG. 116.

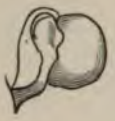


FIG. 117.

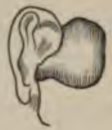


FIG. 118.

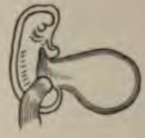


FIG. 119.

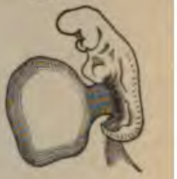


FIG. 120.

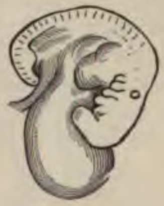
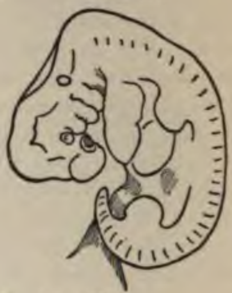


FIG. 121.



Human embryos, first month. × 5. (HIS.)

FIG. 122.

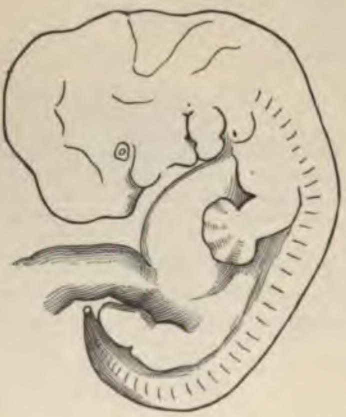
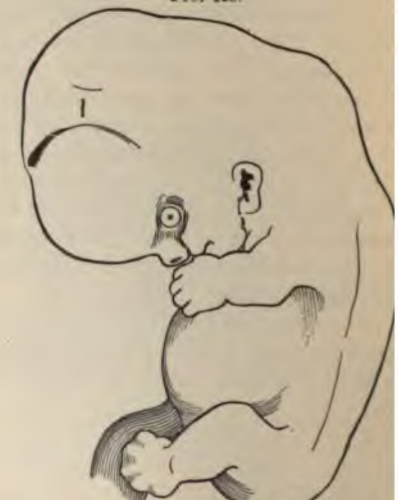


FIG. 123.



Human embryos, second month. (HIS.)

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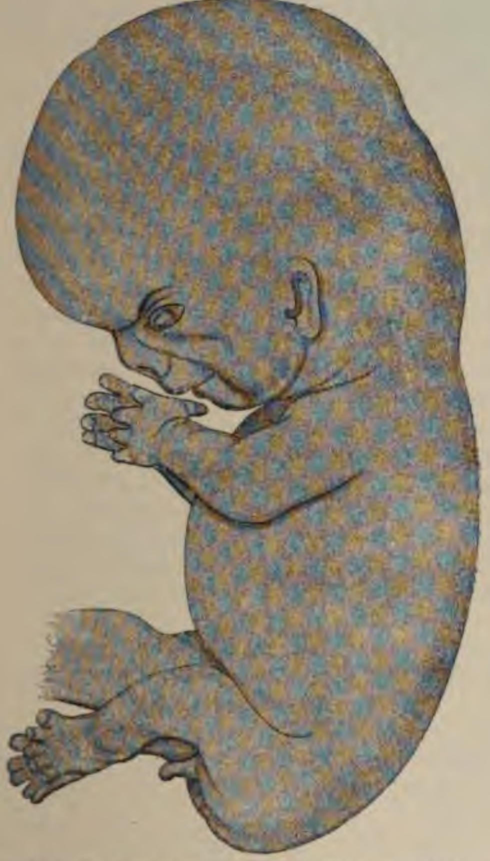
[1] On account of the great variance of tabulated observations and difference in the developme individual embryos of the same age, uniformity and accuracy in weights and lengths are imposs After the second month the weights and lengths given above in grammes and centimetres are t from Hecker's well-known tables. The weights and lengths in grains and inches are from va English and American sources. They must be considered as only approximate.

eyes, anus, mouth. The heart is four-tenths of an inch long. (Figs. 116 to 121.)

Second month—about 2.5 cm., 1 inch long. The eyes, nose and ears are distinguishable. Suggestion of hands and feet. External genitals. (Figs. 121, 122.)

FIG. 124.



Nine weeks' embryo. Magnified four times. (HIS.)

Third month—products of conception about the size of a goose-egg. Fingers and toes separated. Nails as fine membranes. Neck separates head from body. Sex distinguishable; uterus formed. Length, 4 to 9 cm., 5 inches; weight, 5 to 20, average 11 grammes, 460 grains. (Fig. 124.)

Fourth month—10 to 17 cm., 6 inches, long; weight, 10 to 120, average 57 grammes, 850 grains. Short hairs, lanugo, present. Head equal to about one-fourth of entire body.

Fifth month—18 to 27 cm., 10 inches, long; weight, 75 to 500, average 284 grammes, 8 ounces. *Vernix caseosa* forming. Eyelids begin to separate. Heart-sounds perceptible. Quickening takes place.

Sixth month—28 to 34 cm., 12 inches, long; weight, 375 to 1280 average 634 grammes, 23½ ounces. Hair on head. Eyebrows an lashes. Testicles near rings.

Seventh month—35 to 38 cm., 15 inches, long; weight, 780 to 225 average 1218 grammes, 41½ ounces. Pupillary membrane disappears.

Eighth month—39 to 41 cm., 16 inches, long; weight, 1093 to 243 average 1569 grammes, 3½ pounds. Left testicle descended. Nails not protrude beyond finger tips. Lanugo begins to disappear.

Ninth month—42 to 44 cm., 18 inches, long; weight, 1500 to 290 average 1971 grammes, 4½ to 7 pounds.

Tenth month—Lanugo almost entirely disappeared. Skin pink; flex surfaces covered with vernix; both testicles descended in males; lab majora in apposition in females; intestine contains abundance meconium; eyes open. Length about 50 cm., 20 inches.

CHAPTER III.

CHANGES IN THE MATERNAL ORGANISM CAUSED BY PREGNANCY.

The fixation of the impregnated ovum in the uterus begins a series of changes in the organs and structures immediately concerned in gestation, and also, though to less extent, in the organism at large. The changes which take place in the generative organs, being the most important, will first be considered.

The Uterus, the normal site of pregnancy, is the seat of the principal alterations. These changes affect the size, shape, structure, position, and properties of the uterus. They begin at conception, and are for the most part progressive throughout the entire period of gestation.

Size. Coincident with the development of the decidua begins a gradual growth in the size and weight of the uterus, which continues till the later weeks of pregnancy. In the virgin state the uterus measures 7 cm., 2¾ inches, in length, 4.5 cm., 1¾ inches, in breadth, and 2.5 cm., 1 inch, in thickness, and weighs about 42.5 grams, one and one-half ounces. During the ten lunar months of pregnancy it steadily develops, and at the end of that period it is a large, flaccid, vascular organ, measuring about 35.5 cm., 14 inches, in length, 25 cm., about 10 inches, in breadth, 24 cm., about 9½ inches, in thickness, and weighing a kilogram or more, two or two and one-half pounds. It has, therefore, increased in size some twenty-five times. In capacity it has increased from one cubic inch to four hundred cubic inches, and its internal surface is expanded from five or six square inches to three hundred and fifty square inches.

APPROXIMATE MEASUREMENTS OF THE GRAVID UTERUS AT DIFFERENT PERIODS OF PREGNANCY.

Stage of gestation.	*Total length.*		*Width.*	
Twelve weeks	12 cm.	5 inches.	10 cm.	4 inches.
Sixteen "	15 "	6 "	12 "	5 "
Twenty "	18 "	7 "	15 "	6 "
Twenty-four weeks	21.5 "	8½ "	16.5 "	6½ "
Twenty-eight "	25 "	10 "	18 "	7 "
Thirty-two "	29 "	11½ "	20 "	8 "
Thirty-six "	33 "	13 "	23 "	9 "
Forty weeks	35.5 "	14 "	25 "	10 "

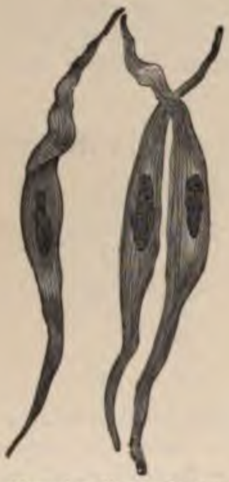
SHAPE. The pyriform shape of the unimpregnated uterus is preserved in the main during the first four or five weeks of pregnancy. There is gradually developed, however, some anteflexion, which persists for a time longer. During the next few months the lower segment expands out of proportion to the growth of the upper segment, and the organ thus becomes nearly spherical; after mid-pregnancy the uterus again assumes a pyriform shape. In the intervals of contraction the uterus is a simple sac with fluid contents, but under the pressure of the abdominal walls it becomes flattened in its antero-posterior diameter, the width increasing at the expense of the length.

STRUCTURE. The first effects of pregnancy are to be observed in the uterine mucous membrane. The increased vascular supply which attends the fixation of the impregnated ovum in the uterus, instead of being followed by the ordinary destructive changes incident to menstruation, becomes the leading factor in a process of hypertrophy and hyperplasia in the mucosa, and results in the formation of the decidua.

The increase in the bulk of the uterus is mainly due to hypertrophy of its structures, and in the later months in some degree to distention. During the first two or three months the growth is symmetrical; later, the fundus and body grow more rapidly than the cervix. First occur a thickening and softening of the mucous membrane, which also becomes more vascular. Similar changes take place in the parenchyma of the organ, owing to hyperplasia of the muscular and connective-tissue elements, and of an increase in the number and size of the bloodvessels, lymphatics, and nerves. In the later months of pregnancy the walls become thinner, till at term they measure from one-sixth to one-fourth of an inch in thickness. This thinning of the uterine walls is the result of stretching, from the distention of the organ by its growing contents. The growth of the uterus in the later months of pregnancy is largely by dilatation.

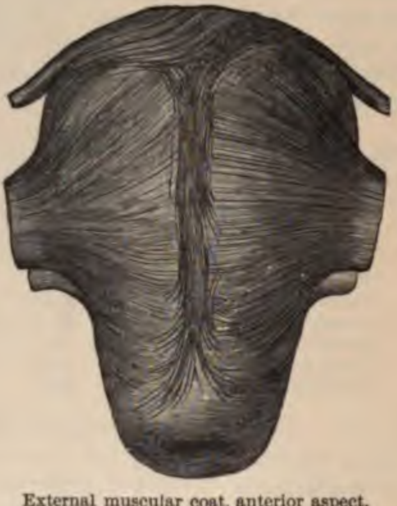
During gestation the non-striated muscular fibres which make up the bulk of the uterine walls are enormously developed, some of them becoming eleven times longer and five times broader than in the unimpregnated state. (Fig. 125.) In advanced pregnancy three muscular layers are easily differentiated. The external layer is thin, and intimately adherent to the peritoneum, sending out bundles to the tubes and to the broad and round ligaments. (Fig. 126.) The middle layer forms the bulk of the uterine walls, and is composed of circular fibres surrounding the vessels and of longitudinal fibres interlacing with one another. (Fig. 127.) The inner

FIG. 125.



Muscular fibres of uterus during gestation. (WAGNER.)

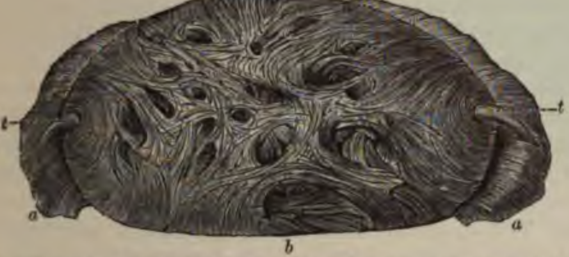
FIG. 126.



External muscular coat, anterior aspect. (DEVILLE.)

layer, also thin, is composed mainly of circular fibres concentrically arranged around the os internum and the orifices of the tubes. (Fig. 128.) Clinical evidence indicates the existence of a sphincter muscle at the os internum; but anatomists are not yet decided upon this point.

FIG. 127.



Middle muscular coat at fundus, where the placenta was seated. The crossing fibres form rings around the vessels which constrict them. (HENLE.)

a, a, superficial layer dissected back; b, bundles belonging to the inner layers; t, t, tubes.

The uterine wall, instead of being hard and firm to the sense of touch, as in the non-pregnant state, becomes so soft and elastic that the fœtal parts can be felt through it.

The arteries become larger and longer and more tortuous; in places they empty directly into the veins.

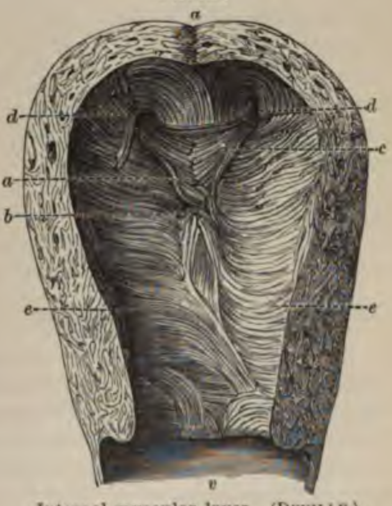
The veins dilate into large channels called sinuses. So closely united are they with the surrounding connective tissue that when cut they do not collapse. The sinuses are largest within the placental area.

The lymphatics participate in the general hypertrophy and hyperplasia of the uterine structures; starting from the deeper portion of the mucous membrane they traverse the muscular layers, and are gathered together in extensive subperitoneal plexuses, which are developed most abundantly over the fundus and sides of the uterus.

The nerves likewise increase in length and thickness, and grow inward toward the uterine cavity. The cervical ganglion is more than doubled in size, and smaller ganglia may be observed on the inner surface of the uterus.

The peritoneal covering of the uterus grows by formation of new tissue-elements as the uterus develops. It has only a loose attachment to the lower segment of the womb.

FIG. 128.



Internal muscular layer. (DEVILLE.)

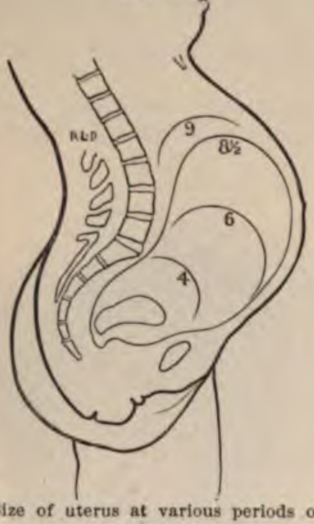
a, section of anterior uterine wall; *b*, triangular bundle; *c*, fibres running to the tubes; *d*, *d*, orifices of tubes; *e*, *e*, transverse fibres; *v*, vagina.

POSITION. At the same time with the changes already mentioned there appear marked alterations in the position of the uterus, varying from time to time as pregnancy advances. During the first and second months the increasing size and weight of the organ cause it to assume a somewhat lower position in the pelvic cavity, with but little alteration of the normal axis. But during the third month a still greater increase in size and weight, in conjunction with the force of gravity acting upon the upper end of the uterine lever, causes the fundus to fall forward, and a corresponding rise of the cervix to take place. There is an increase in the normal anteversion of the uterus.

Since, during the first three months of pregnancy the enlargement is principally in the antero-posterior and lateral diameters, the uterus remains within the true pelvis, the fundus not rising above the symphysis pubis. In the early part of the fourth month the longitudinal increase becomes apparent, and the growing uterus can no longer be accommodated within its former boundaries; it begins to rise above the pelvic brim; at the fifth month it fills the hypogastrium, and at the sixth it reaches to the level of the umbilicus.

At about eight and one-half months the fundus is nearly in contact with the ensiform cartilage. (Fig. 129.) Within the last two weeks of pregnancy the uterus sinks more deeply in the true pelvis, and assumes a lower position than before, the fundus resting downward and forward from 7 to 8 cm., $2\frac{3}{4}$ to $3\frac{1}{4}$ inches, below the ensiform cartilage. This sinking of the uterus is termed lightening. In primiparæ the descent of the pregnant uterus within the true pelvis is more noticeable, because of the greater rigidity of the abdominal walls. The descent of the fœtal head into the pelvic brim during the last weeks of utero-gestation affords satisfactory evidence that the pelvic inlet is relatively ample.

FIG. 129.



Size of uterus at various periods of pregnancy.

The position of the uterus is influenced also by the posture of the woman. When she stands, the body of the uterus is supported by the anterior abdominal wall; when she is in the recumbent posture, it rests against the vertebral column, with the fundus approaching the diaphragm; when in a lateral posture, it gravitates to the dependent side.

After the body of the uterus has risen out of the lower pelvis its axis is generally inclined to the right, and the uterus is rotated somewhat to the right, its anterior surface looking toward that side.

PROPERTIES. The foregoing changes in the uterus imply the assumption of new and unusual properties. The muscular walls, with their enormously hypertrophied fibres, are yielding and elastic. This elasticity permits of the movements of the fœtal body common to this period of gestation. The uterus gradually acquires an increased irritability, and responds more readily to stimulation of its muscular fibres. Growing contractility causes the physiological phenomena of painless and painful contractions common during the later weeks of pregnancy.

The Cervix. Many varying opinions exist as to the part played by the cervix in the general uterine enlargement. Discussion in this place is unnecessary; it is sufficient to say that the weight of evidence favors the belief that the cervix has a limited share in the formation of the fully developed body of the pregnant organ. As previously stated, during the first three months of pregnancy the growth is about equal in all parts of the uterus, the cervix reaching a length of little more than 5 cm., 2 inches. The assumed shortening of the cervix during the later weeks of pregnancy is only apparent. The actual length of the cervix remains undiminished till the onset of labor.

The hyperæmia which attends the development of the cervix occasions a physiological softening of the tissues, manifested first in those portions of the cervix in which the least resistance is encountered, viz., under the mucous membrane at the os externum, and extending thence from below upward toward the os internum, the progress of the softening being relatively more rapid toward the end of pregnancy. The follicles of the cervical mucous membrane furnish an abundant supply of thickened secretion, filling the canal and forming what is called the "mucous plug." The orifices of the mucous follicles frequently become occluded. The sacs then become distended with their own secretion, and project from the surface of the mucous membrane, forming the Nabothian ovules. The cavity of the cervix is dilated and funnel-shaped, admitting the finger-tip to or through the internal os in the last month.

During the later weeks of gestation the cervix measures 4 cm. (from 1¼ to 1½ inches). Immediately before labor the vaginal portion of the cervix projects less and less into the vagina; the apparent shortening being due to the swelling of the vaginal walls and of the tissues at the junction of the cervix and vagina, and to the traction exerted by the longitudinal and diverging muscular fibres of the corpus uteri. In primiparæ the changes in the cervix begin at an earlier period, owing to the greater resistance of the tissues of the uterine body.

The Adnexa. The folds of the broad ligament gradually become separated, and at the end of pregnancy the ovaries and Fallopian tubes are in close contact with the uterus, the ovaries assuming a vertical position above the pelvic brim, the left ovary being accessible at times on palpation. The tubes are vertical. The thickened round ligaments may be detected during a contraction; the location of their upper ends gives a clue to the seat of the placenta. If these cords run from the middle of Poupart's ligament halfway up the uterus, a high position of the placenta is determined. Conversely, ligaments reaching high on the ovoid point to a lower placental insertion. Round ligaments converging on the anterior face indicate posterior implantation, while convergence behind gives warning that the incision for Cæsarean section will start a vigorous hemorrhage as the operator opens the anterior uterine wall.

The Pelvic Peritoneum, in its relation and disposal, undergoes marked changes, in regard to which there is not entire unanimity of opinion. It is obvious that the peritoneum on each side of the uterus must be elevated to a considerable extent during pregnancy, but with reference to the peritoneum covering the anterior and posterior fossæ—the vesico-uterine cul-de-sac and that of Douglas—there is some difference of opinion. Polk holds that these, too, are raised by the mechanical action of the uterus during its growth, which at the same time strips the peritoneum from the bladder. On the other hand, the observations of Webster on frozen sections seem to prove that the floors of the two fossæ mentioned are as low during pregnancy as in the nulliparous state. According to the latter author, the bladder is stripped of its peritoneum by the sinking of the pelvic floor.

The Vagina partakes of the increased nutritive activity of pregnancy. Growing vascularity causes thickening and softening of the mucous membrane, which furnishes a more abundant secretion. The enlarged vessels of the venous plexus impart a bluish or violet color to the vagina. The vagina is increased in length, and though it is drawn upward by the uterus during pregnancy, the columns of the anterior wall frequently protrude from the vulva. The swollen papillæ cause the mucous membrane to present a granular feel to the examining finger.

The External Genitals share in these changes. The largely developed bloodvessels and lymphatics and the increased vascular tension induce a condition of softening and infiltration which causes the vulva to gape and to appear particularly prominent. The venous turgescence gives to the vulva a dusky hue. The increased vascularity results in a condition of great functional activity on the part of the sweat-glands and sebaceous follicles.

The Pelvic Floor undergoes a downward displacement during pregnancy, which by the end of gestation results in nearly doubling the skin-distance from symphysis to coccyx.

The Articulations of the Pelvis are softened by an increased vascularity of the inter-articular cartilages. The symphysis pubis is the joint most affected ; it is to an extent loosened, thus permitting a limited degree of mobility toward the end of pregnancy. As a rule, these changes in the articulations contribute very little to the enlargement of the pelvis. Should they become pronounced, they may give rise to great inconvenience in locomotion. The sacro-coccygeal articulation is mobile in all women during the first fifteen years of the child-bearing period, and during the expulsion of the child permits recession of the coccyx to the extent of one inch.

General Changes. Pregnancy is the cause of numerous and important changes in the maternal organism at large. Although different parts of the body and numerous physiological functions are involved, they are not all equally affected. These changes are manifest particularly in the nervous and the circulatory systems. Pregnancy being a physiological process, the organism displays great adaptability in meeting these changed conditions. The pregnant woman breathes, provides nourishment, secretes and excretes not only for herself but for the growing fœtus as well. The normal woman is perfectly able to meet these additional demands when occurring within certain limits, beyond which disturbances of health are likely to supervene. In most instances there is an apparent improvement in the general health during gestation, as though an extra store of energy were being accumulated for the coming ordeal of parturition.

Circulatory Changes. Headaches, ringing in the ears, flushed face, cardiac palpitation, and dyspnœa, which are common symptoms of pregnancy, led the older practitioners to think that there was present a condition of plethora, in consequence of which, thirty-five years ago, it was a common practice to perform venesection upon pregnant women. Now that the blood conditions are better understood, such practices have very properly become obsolete.

The blood is somewhat altered in composition and increased in quantity. Extreme changes, formerly believed to take place, do not occur in healthy gravida. During pregnancy the watery elements and the proportion of white corpuscles are increased. In general, the albuminous constituents are diminished. After parturition large quantities of excrementitious material, from both the fœtal and the maternal organisms, are thrown into the blood. It is reasonable that the blood should be increased in quantity during pregnancy, for the amount necessary before gestation would be inadequate to meet the additional requirements of fœtal nutrition. The condition is not a true plethora, but simply an increase in the amount of serum. The diet of the pregnant woman, as well as her hygienic surroundings, profoundly affect the quality of the blood. Unsuitable diet and unhygienic surroundings may cause a condition of marked anæmia and hydræmia. The extra nutritional demands must be met by careful attention to the two elements mentioned. Changes in the blood are most pronounced at the close of gestation, the decided increase in the fibrin factors is often evidenced by thrombotic tendencies at this time and shortly after labor.

Disturbances often follow these changes in the circulatory system. At first, palpitation is purely sympathetic in character, but latterly the pressure on the diaphragm from the growing uterus interferes directly with the heart's action. Œdema not infrequently results from the alterations in the character of the blood.

It has long been taught that the left side of the heart undergoes hypertrophy in the gravid woman. It has recently been shown that there is no actual increase in the size of the heart during pregnancy. The apparent enlargement is due to displacement. That no hypertrophy occurs has been proved by observations upon the weight of the heart in women dying in the later months of gestation. No increase in weight has been observed to meet the increasing demand upon the circulation as pregnancy advances.

The spleen increases in size, as does also the liver. Fatty degeneration occurs in both viscera. The thyroid gland, by reason of its nutritional and circulatory relations, undergoes an increase in size, and in women who possess a tendency to enlargement of this gland, pregnancy may still further stimulate its growth.

Respiratory Changes. The enlarging uterus acts mechanically to modify respiratory movements. Upward pressure upon the diaphragm, reducing the longitudinal diameter of the chest, prevents free respiratory action, notwithstanding the fact that the transverse diameter of the lower thorax is increased. As the end of gestation approaches, the uterus sinks slightly, thus materially relieving the hitherto embarrassed circulation and respiration. Since, during pregnancy, the quantity of blood to be purified is increased, it follows that there must be an increase in the amount of carbonic-acid gas excreted by the lungs. Cough and dyspnœa may be entirely sympathetic when occurring during the early months of pregnancy, but in the later weeks there exists a distinct mechanical cause for such symptoms. Such evidences of disturbance are more frequently the result of a twin pregnancy, or of amniotic dropsy.

NUTRITIONAL AND DIGESTIVE CHANGES. Upon the digestive system rests the responsibility of providing nutritional elements to meet the greater demand. Larger quantities of food are required, and it follows that there must be an increase in digestive activity, as well as additional work for the excretory organs to perform. Digestive disturbances, including nausea and vomiting, are so common in the early months as to be an almost constant concomitant of pregnancy. They are present in the vast majority of cases during the second and third months, gradually disappearing as pregnancy advances. With their cessation, appetite usually returns, the digestive activity is increased, and there is marked improvement in the general nutrition. Irrespective of the growing uterus and ovum, and often even despite nausea and vomiting, there is normally a steady gain in body-weight. Although constantly progressive, the gain is most marked in the last two months, and for the entire period of gestation it amounts to from ten to fifteen pounds. The fat is the tissue most largely increased; it is deposited particularly in the mammary glands, about the buttocks, in the abdominal parietes, and omentum. The figure becomes fuller and rounder. This increase of stored potential energy is to be utilized after delivery, when the physical powers are taxed by lactation.

PUERPERAL OSTEOPHYTES sometimes develop on the inner surface of the frontal and parietal bones. They are irregular in outline and are composed of calcium carbonate, traces of phosphates, and organic matter. They are not peculiar to pregnancy, and may sustain some relation to the calcareous changes in the placenta and to the forthcoming milk secretion.

There is no material alteration of the body temperature during pregnancy.

CHANGES IN THE SKIN, THE GAIT, AND THE OSSEOUS SYSTEM. The hair follicles, the sebaceous and sweat glands are more active during pregnancy. It has been stated that the growth of hair is invigorated at this time. Pigmentations, occurring in isolated patches over the body, are often observed; these are particularly noticeable upon the abdomen, the face, and around the nipples, the primary and secondary areolæ. A dark pigmented line, the linea nigra, is frequently observed extending from the umbilicus to the symphysis, and sometimes continued to the ensiform cartilage. These pigmentations vary in different subjects, being more marked in brunettes than in blondes. After parturition they are diminished in intensity, but rarely disappear.

In pregnancy there is a marked change in the gait and carriage, particularly noticeable in short women. In order that the equilibrium may be maintained, the head and shoulders are thrown backward.

Because of the drain on the osseous elements of the blood, a fracture occurring during pregnancy does not unite readily.

URINARY CHANGES. The kidneys, which are supposed to be enlarged, furnish a more abundant supply of urine of a lower specific gravity. This functional activity is due to increased arterial tension. The qualitative changes in the urine are an increase in the chlorides, and a diminution of the phosphates and sulphates, which are used by the growing foetus. The pellicle, kiestein, often found upon the cold urine of pregnant women, is not peculiar to pregnancy; it is observed under other conditions, and even in the opposite sex.

Sometimes lactose makes its appearance in the urine during the later weeks of pregnancy, and during beginning lactation. The proportion depends upon the relation of supply and demand, diminishing as the balance is established.

The writer has determined by observation of a large number of cases that from 5 to 10 per cent. of pregnant women have albuminuria, usually small in quantity and extending over short periods only. It is more likely to be present during parturition than pregnancy, and is especially apt to follow a long and difficult labor.

CHANGES IN THE NERVOUS SYSTEM. Marked changes in the mental characteristics of the woman are common. She may become fretful, peevish, irritable, and at times unreasonable. The tendency to emotional disturbances is increased. The nervous system becomes extremely impressionable. Home surroundings, whether agreeable or not, may exert a profound influence, either for good or for evil. Slight ailments, which at other times would affect the nervous system but little, may have an exaggerated import. These symptoms may progressively increase in intensity till during the latter part of pregnancy, or soon after labor temporary or even permanent melancholia or mania may result.

CHAPTER IV.

DIAGNOSIS OF PREGNANCY.

METHOD, clearness, and perspective are not more necessary to the student in learning the signs of pregnancy than is the acquisition of a habit of orderly procedure to the practitioner in making a diagnosis of this condition. The difficult cases are many; the result of error is ridicule. Vander Veer has collected sixty-eight instances of operation on supposed pathological growths, some of the operators being men of note. The laity imagine that it cannot be hard to tell whether or not there is a child in the womb, and often insist upon a positive conclusion. This demand is strongest in the early weeks when the signs are fewest and faintest. A relatively large amount of space has, therefore, been accorded to the changes in the second and third months, and to their literature, whereas the later major signs are our common property, whose history may be omitted in this short chapter.

In addition to the main question—whether certain indications are or are not present—the examination will necessarily touch on the possibility of the diseases that simulate each sign; the estimate of the period to which gestation has advanced, in order to collate all the signs due at that period, and the queries whether the pregnancy is normal or abnormal, the child alive or dead. Many other facts, very nearly connected with the subject-matter of this chapter, but more commonly inquired into a month before labor, are relegated to the antepartum examination, which may be found under the chapter on the Management of Labor. In quizzing, one asks concerning each sign: what its character is, its cause, the method by which it is brought out, its location, the date of appearance and duration, and what conditions other than pregnancy may counterfeit or develop it. Only through bedside instruction can the student learn the look of the areola or acquire skill in palpation and auscultation.

The *four steps of the examination* follow an obvious order: History from the patient; physical exploration, mammary, abdominal, pelvic.

I. HISTORY.

The chief symptoms obtainable from the patient are cessation of menstruation, nausea, enlargement of the breasts and abdomen, and quickening.

Suppression of Menses. After conception menstruation ceases. This is usually the first sign to draw attention to the condition. "In a woman of previously regular menstrual habit, and in the absence of other appreciable causes of amenorrhœa, the arrest of the catamenia is to be regarded as strong presumptive evidence of pregnancy."[1] The importance of this evidence increases after the second omission, since belated appearance of the flow for a few days to two weeks is not uncommon. It is most weighty, as indeed may be said of all the signs, when it corresponds in time with the size of the uterus and the usual date of appearance of the other evidences of pregnancy.

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[1] Essentials of Obstetrics, by Charles Jewett. Lea Bros. & Co., Phila., 1897. From this book the writer's classification is mainly drawn, with much more besides.

Three things lessen the value of this sign :

a. There are other causes of amenorrhœa. These are mainly anæmia, tuberculosis, chilling, delay in menstruation, emotional causes, nephritis, as well as change of climate, obesity, the menopause, pelvic inflammations and tumors, and an irregular menstrual habit. Newly married women or those fearful of the results of wrong-doing are rather prone to run over their time; the sea voyage checks the flow with our immigrants; or the climacteric may arrive early.

b. An apparent menstruation may take place in early pregnancy. This is infrequent, so that a woman who is unwell regularly, however scantily, is almost always wrong in her suspicion of pregnancy. When a periodic flow does occur during gestation—and a woman calls any more or less periodic flow her courses—careful questioning will elicit evidence of lessened quantity, a thin or serous character, or some variation in typical increase and tapering off. Such flow rarely takes place after the third month, when the decidua reflexa and vera have no longer a cavity between them. The source lies usually in some lesion of the cervix, in an endometritis or polyp, or even in a placenta that is prævia. A patient illegitimately pregnant not infrequently denies amenorrhœa, or places the last period later than the true time. The denial may be volunteered in the hope that during local treatment a sound will be passed. A few cases have been reported wherein menstruation apparently continued throughout pregnancy, or took place then only.

c. Pregnancy sometimes begins in patients not menstruating. Conception may occur before the function is established, as is *de rigueur* among certain of our Indian tribes; or after the function has ceased; or it may take place during the physiological amenorrhœa of lactation; or, lastly, in those who are in the habit of skipping periods. It should be said also that impregnation happening just before a period may affect it little.

Nausea and Vomiting. This is a frequent accompaniment of early pregnancy, ranging from an occasional qualm to inability to retain any food. It is a reflex from the stretching of the uterine muscle-fibres and nerves or from pressure in the pelvis. Occurring late in pregnancy, pressure and displacement explain it. The grades or degrees may be placed in the following clinical groups: (*a*) Nausea absent or slight in a considerable percentage of cases; (*b*) nausea with occasional vomiting during the second and third calendar months (fourth to thirteenth weeks)—a very common condition; (*c*) long-continued, distressing, debilitating, but not dangerous, retching and vomiting; (*d*) vomiting imperilling the health, and (*e*) threatening life. The disorder is generally a morning sickness on first rising, or may be only after meals, or solely when the stomach is empty. Infrequently it begins soon after conception, and may last throughout gestation.

Its value as a witness to pregnancy is scant, since it occurs in gastric catarrh, chronic nephritis, and as a reflex in pelvic disorders and many others. If it has always appeared at a given time in previous pregnancies, it has some weight.

Salivation many times accompanies the sickness. The secretion is tenacious and difficult of expectoration, hence the name "spitting cotton." Heartburn, abnormal appetites, longing or loathing toward various strange articles of food, toothaches, and the like, may be present.

Enlargement of the breasts, with throbbing, tingling, stretching fulness, or secretion, may be complained of, with tenderness of the nipples, and the patient may have noted that her clothes are too tight, but all these are matters belonging to the physical exploration. We need only mention irritability of the bladder and altered or perverted sensations, to dismiss them as of no moment.

Quickening is the sensation imparted to the mother by fœtal movements, from the least tremulous flutter to painful somersaults that keep her awake with acute pain. The motion is usually perceived midway in pregnancy, yet may be felt in pregnancies other than the first as early as the third month, or it may never be discovered throughout. Its importance lies wholly in the mind of the laity. Movement of gas in the bowel counterfeits it, and muscular contractions in the belly wall. Or the sensation may exist only in the imagination. Cessation of motion may be due to death of the fœtus, but temporary or even permanent stoppage of these feelings on the mother's part is not incompatible with a living child.

II. MAMMARY SIGNS.

Summary of Signs and Approximate Date.

1. Increased size ; nodular feel	End of 2d month.[1]
2. Veins	
3. Changes in primary areola ; pigmentation, elevation, wrinkling, follicles	
4. Milk	3d month.
5. Secondary areola	5th month.

1. **The Breast Enlargement** of pregnancy differs from simple fat deposit by the firmness and knotty, uneven character to the touch. This is due to increase in size and number of the glandular lobules, swelling of the connective tissue, and increased deposit of fat between the lobules. In the early months the change is to be distinguished most clearly at the edge, but later the strings of nodules or tiny grape-clusters seem to extend toward the centre. Still later a certain relaxation in the whole breast is seen. The tension may stretch the skin into silvery lines, like the striations on the abdomen, and these constitute permanent markings, often purplish in color.

2. **The Veins** enlarge, forming a blue tracery under the skin or slightly elevated above it. They run across the breast and into or around the areola. To bring them out fully the centre of the breast may be circled with pressure for a moment, preferably in a bright light that strikes the surface obliquely.

3. **The Primary Areola.** PIGMENTATION. The darkened base on which the nipple stands becomes in women of the brunette type the seat of a pigment deposit that renders it not unlike the tint of the negro's skin, ranging from reddish-brown and brown to black, the depth of color usually depending on the patient's complexion. In very light blondes there may

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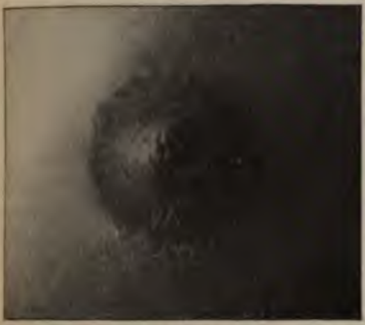
[1] In this chapter the word "month" denotes the calendar month.

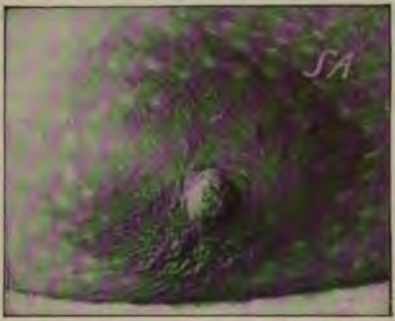
be no discoloration, though often, even when pigment is not visible, reddening or a congested look is noticeable—"the delicate rose-color" of Montgomery.

FIG. 130.



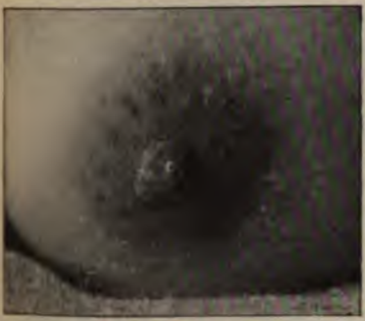
Brunette. Pigmented primary areola; slight secondary areola.

FIG. 131.



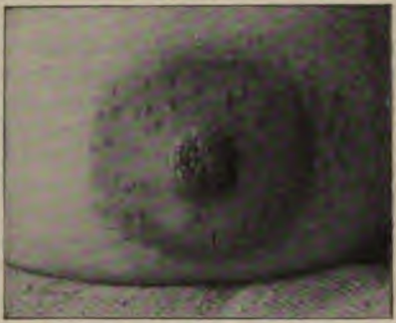
Brunette. Wrinkling of primary areola. Well-defined secondary areola, S. A.

FIG. 132.



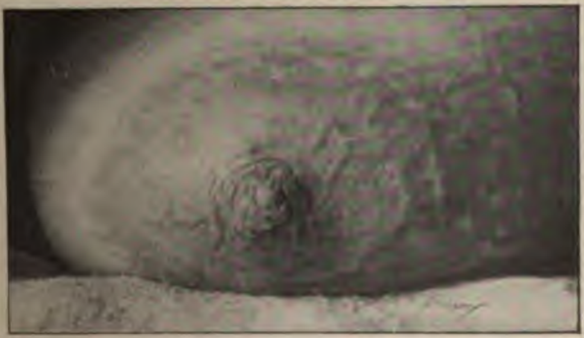
Blonde. Follicles, F. Milk. Faint secondary areola.

FIG. 133.



Blonde. Elevation (E) of primary areola. Follicles. Secondary areola.

FIG. 134.



Relaxed breast of multipara. Veins. Secondary areola.

ELEVATION of the areola is common in fair women. The puffy thickening and œdema, raising the surface slightly, level or rounded, like a tiny breast on the breast, are readily brought out or accented by gently putting the surrounding skin on the stretch.

WRINKLING or contractility of the areola is produced by the increase in sensibility and size of the subareolar muscle. These bands, mostly circular, are 2 mm., $\frac{1}{16}$ inch, in thickness, according to Testut. Friction or cold or emotion will cause contraction, thereby puckering the skin of the areola over them, and throwing the nipple forward. This is in no sense an erection, although the phenomenon is commonly called erectility of the nipple.

MONTGOMERY'S FOLLICLES make up two to twenty small papular prominences on the areola, 2–3 mm. high. They are enlarged sebaceous follicles, and at times moist, lubricating the nipple. Stretching of the skin or action of the muscle of the areola renders them more easily seen.

4. **Milk.** Pressure on the breast and a moment's dextrous stroking of the ducts running toward and beneath the areola will bring colostrum after the third month. There may be branny, dried scales of it on the nipple. It is water-like, or slightly opaque, or later, occasionally yellow. This is the most important of the mammary signs in the woman pregnant for the first time, but, inasmuch as milk persists in the breast thereafter, it gives no help in other pregnancies. As a curiosity, it may be mentioned that milk has been found in virgins, or has been developed in them—or even in the male—by nursing. The primitive man is supposed to have helped suckle the young, when families were larger.

5. **Secondary Areola.** Where the primary areola fades into the skin there appears, at the fifth month, a network of pigment around a certain number of light spots, each tiny circle having for its centre the opening of a follicle. These washed-out spots are rarely absent altogether, usually run about the circumference of the dark surface, and may extend all over the breast. Next to the milk this is the most valuable of the mammary group in the primigravida.

Value of the Mammary Signs. In first pregnancies, with no history of long-continued pelvic disease, the changes enumerated above furnish strong presumptive evidence of pregnancy. They are important in conjunction with other signs. All the indications are rarely present at once in the same case. After the first gestation the signs remain. Various ovarian and uterine disorders, such as tumors, may bring about similar appearances. Masturbation frequently does it, in a certain degree, even where the nipple is not handled.

In practice, breast indications help one in the unmarried suspect. A girl with amenorrhœa and nausea is not to be lightly subjected to bimanual examination or to a question that may be a grave insult; but, under the pretext of investigation of the heart or lungs, the sight of a nipple that shows distinctive alterations will warrant further steps.

Finally, if pregnancy exists, we look to the organ's fitness for function, and teach the patient to bring out a stunted, creviced, inverted, or tender nipple by massage and traction.

III. ABDOMINAL SIGNS.

Summary of Chief Signs and Approximate Date.

On palpation :	
1. Size of tumor, and typical growth	**From 4th month.**
2. Intermittent contractions	**4th month.**
3. Fœtal parts	**5½ months.**
4. Fœtal movements	
5. Abdominal ballottement	
On auscultation :	
6. Fœtal heart	**4½ months.**
7. Uterine souffle	

Preparation for Examination. With clothing unfastened and opened, and all waist-bands loosened, with corsets off and bladder emptied, the patient lies down on the office table or on a firm bed or lounge. A pillow bends the head somewhat forward on the chest, and the shoulders are preferably slightly raised by an inclined plane resembling a bed-rest or by a second pillow under the first. This forward curve of the spinal column does not extend below the scapula. Such a position, with the legs and thighs flexed, relaxes the abdominal walls to their utmost, except very late in pregnancy, when a straighter posture is better. A sheet covers the legs and trunk ; through this or under this examinations may be made in most instances, but one uncovers to listen with the stethoscope or for thoroughness in obscure conditions.

Warm hands have a more acute sense of touch than cold. Cold contacts will cause reflex contraction of the muscular walls. Gentle palpation may bring out all the facts. The skilful use of some force may yet give the impression of light-handedness by gradual increase of pressure. One does not prod with the finger-tips nor play the piano on the surface. With the finger edges touching, the facies of the last phalanges pass along the uterine walls. This is one kind of touch—the circling, sliding contact. The other is a quick push or gentle thrust, to estimate the various resistances. The latter gives more information, but is resented by a sensitive surface.

The examination is made in due order : inspection, palpation, auscultation.

Inspection.

Contour. It is said that in the second month the hypogastric region is flatter and the umbilicus deeper than normal. *Enlargement* of the abdomen begins after the third month, as the uterus rises well above the brim of the pelvis. Regular increase takes place until two to four weeks previous to delivery, when "sinking" or "lightening" occurs, the lower pole settling into the pelvis, and the patient experiencing the comfort of easier breathing and looser waist-bands; but, on the other hand, disturbed by increased bladder pressure. Typical evidences of settling are absent in very many women.

The protrusion of the belly-wall is not symmetrical, being commonly most distinct in the later months to the right of the median line, owing to the torsion of the uterus. Fat deposits in the gluteal regions and over the hips are noticeable in addition to that in the abdominal wall itself. The navel may protrude as the development nears term.

Pigmentation and Striation. Along the median line of the abdomen a dark track of brown is clearly traced from the pubes around the navel and up to the ensiform cartilage. It is discolored most in those with darker skins, and is one-eighth to one-half inch in width. It is part of the pigment dropped in places where capillaries are few, along the front fœtal closure line, on the lips, abdomen, vulva, and perineum (Ahlfeld). The other pigment markings or spots on the face and body are mostly a vegetable growth (chromophytosis). The darkened abdominal line may be found in boys, in virgins, in brunettes, and in pelvic disorders. This change begins in mid-pregnancy.

Streaks or striæ, resulting from stretching of the skin, appear on the lower abdomen. These "lineæ albicantes" vary in color from silvery white through pink to bluish and faint purplish tints. They are wavy and irregular, and in direction commonly lie in concentric zones around a centre just below the umbilicus. They belong chiefly to the last trimester. The skin injury is permanent. On the breasts, the thighs, and the buttocks the markings are also seen.

Value of Inspection Signs. Any other cause for abdominal enlargement or skin tension will produce like effects; therefore, these things are of no import. We enumerate them for completeness in description.

Palpation.

The signs brought out by this means are: Size of uterine tumor and regular growth, intermittent contractions, fœtal parts, fœtal movements, and abdominal ballottement.

Size. The fundus may be felt as it begins to rise two or three fingers above the symphysis in the fourth month (sixteenth week). At about the sixth calendar month (twenty-sixth week) the navel is reached, although this landmark varies so greatly in its distance from the pubes and ensiform that it constitutes a measure of no great accuracy. The ensiform is reached with the maximum height at eight and one-half months (thirty-sixth week), while at term the rounded upper limit of the uterus is somewhat lower. To find the fundus most readily the hand is laid transversely above the expected level, and its ulnar border depresses the abdominal wall; this edge works slowly downward until the uterus is capped by the bowed hand.

To be of value the development of the organ must be progressive and correspond in a general way to the supposed duration of pregnancy as evidenced by other signs. Advance is most rapid in multigravidæ, particularly where the abdominal muscles are lax, the whole organ standing high out of the pelvis; with twins or hydramnion, and in vesicular mole. In certain cases no sinking of the fundus occurs, nor is it found where the muscular layers lack tone, or where an obstruction or a placenta holds the presenting part up out of the pelvis. The factors affecting the height are so various that exact figures possess scant value.

Incidentally note is taken of pendulousness of the abdomen, excessive fat deposit, diastasis of the recti muscles, and tumors in the uterine walls or in the neighborhood.

Fœtal Parts. The characteristic to the touch which differentiates this tumor from other smooth, ovoid, or pear-shaped semi-fluctuating cyst-like growths, is that some parts are harder, some softer; that the solid parts are of various sizes; that these surfaces and knobs can be identified as actual parts of a child—more particularly as the limbs and head and back. These landmarks may disappear under a general resistance as the womb-wall contracts, to reappear as the tension passes off. Occasionally the face or the feet may be distinctly recognized.

Fœtal parts clearly felt furnish one of the two or three best signs of pregnancy. It is most uncommon to find a tumor bearing distinct resemblance in shape to a fœtus. In cases of excess of liquor amnii or tender or tense uterine walls, one may be unable to outline the child. Fœtal parts may be detected in the sixth month or a little earlier.

Fœtal Movements. The hand laid quietly on the abdomen detects a thrust or push within the womb. Early, it is felt as the gentlest of throbs. Later the motion is either general or local; either the entire body changes its position by partial rotation, with a rolling, sliding motion, or else quick blows are dealt at one or more spots; or, finally, a prominence travels along under the lifted skin. To bring out such action in a quiescent fœtus one may have to gently push or toss the child. The motion is most easily developed at one cornu where the feet are found.

This sign, when clearly detected by the examiner, ranks with the last in importance. It may be simulated by bubbling of gas in the bowel or by localized contractions of the abdominal muscles. These resemblances are said to be occasionally very deceptive, and women themselves are not infrequently deceived, but patience should always give the medical man certainty. Sometimes the motions are rhythmic. Failure to detect movements does not necessarily mean a dead child nor exclude pregnancy.

The date of detection depends on one's skill, in part. By the time the fœtus is a foot long the impulse is vigorous enough to feel—that is, by the sixth month—often earlier.

External Ballottement. This is the sensation imparted by a displaceable mass floating more or less freely in fluid. A hand on either side of the fundus, the operator facing the mother's face, may be able to push an irregular bulk to and fro; or the fœtal part may be rapidly moved under the hand; or, typically (therefore seldom), the fingers may, with a light, quick thrust, drive away a ball that bobs back again against their tips. This distinctive "dipping" and return, or repercussion, is only felt by the route of the abdomen in cases with abundant amnial fluid, or in thin persons, in the fifth month, through the fundus. The best demonstration of this sign is to be had when the head is in the fundus and is cast to and fro as it balances over the shoulders.

The date of detection of this form of tossing is usually after the uterus has risen well into the abdominal cavity—the sixth month. The value of the sign is great, and only pedunculated tumors or wandering organs like the kidney are likely to simulate it.

Intermittent Contractions. A rhythmic and painless hardening of the uterine walls occurs every five to ten minutes, lasting from one-half to five minutes. The contractions may be elicited by friction or by the touch of the cold hand. These alterations in tension are noted as soon as the fundus is high enough to grasp—that is, from the fourth month;

but by conjoined manipulation are appreciable from the earliest beginnings of pregnancy.

This sign has a definite value as showing a condition of hypertrophy of the muscular wall of the uterus, and because the disorders that likewise develop this reflex are infrequent. A uterus distended by retained menstrual blood (hæmatometra), or by a soft uterine fibroid, will act in the same manner. A greatly distended bladder will give the same sensations.

In practice the muscular contraction is of service also, because the rigid round ligament gives us knowledge of the seat of the placenta, information especially desired in case of Cæsarean section.

Percussion is infrequently employed because we can map out the gravid uterus otherwise. In tense abdomens it serves. It may be stated as a rule that after the fifth month the uterus is always in contact with the front wall of the trunk-cavity with no intestinal loops intervening.

Auscultation.

The ear brings out four evidences of pregnancy: Fœtal heart, uterine and umbilical murmurs, and fœtal shock.

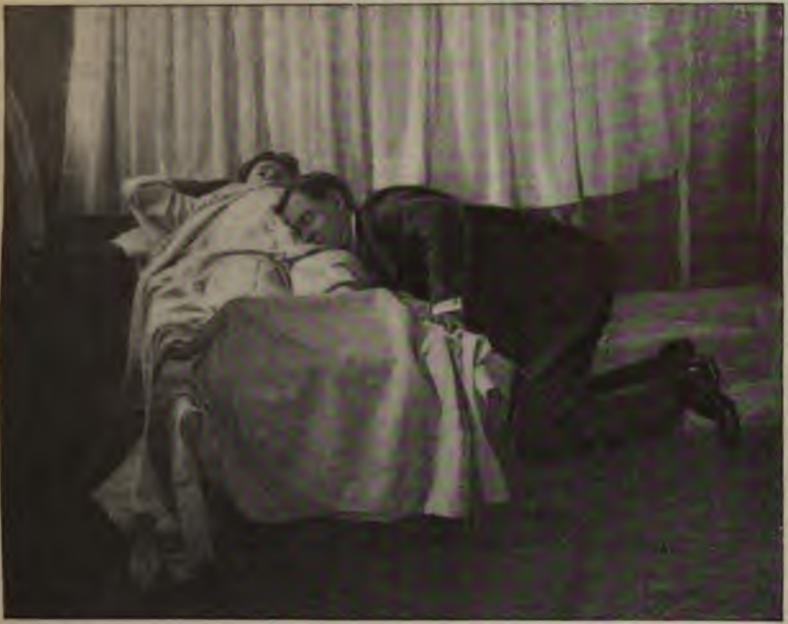
Fœtal Heart. The sound is generally double, like that of the adult apex, and at a rate nearly twice that of the maternal pulse. It has been often compared to the muffled tick-tack of a watch under a pillow. A clearer notion may be acquired by the student who listens through an infant's back. To count it calls for practice on his part, but skill comes with persistence and arms him for two important occasions.

The rate is between 120 and 150, and may be increased by the activity of the child and by fever of the mother. The rapidity is greater at the beginning of a pain, slowing as the pressure increases (seldom dropping below 100), even ceasing momentarily at the acme. Variations of 20 beats in the same fœtus are frequent. Sex cannot be determined by the rate. Boys and larger children were supposed to have slower heart-action than girls and smaller children, and the percentage does fall a little in their favor, but the Frankenhäuser theory, that this is reliable or even an approximate index of sex, is discarded.

The heart is heard most commonly between the navel and the anterior superior spine of the ilium on the left side, because the back of the child is located there in the usual position, the left-occipito-anterior. If the previous palpation has indicated that the back will be found in some other place, we listen in that spot, and confirm the diagnosis of position. In the flexed fœtus the heart is placed as near one extremity as the other; it is heard below the navel when the head presents, because the head sinks into the pelvic brim. Should the breech present, the focus of greatest intensity late in pregnancy will be above the umbilicus or at its level. There is some property of the living tissues that prevents the heart from being heard over an area larger than 2 to 4 inches, 5 to 10 cm. A second focus may be detected at the spot where another part of the child presses against the wall, or in case of twin pregnancy. Faint hearts are heard over a small area. Occasionally a wide diffusion is encountered.

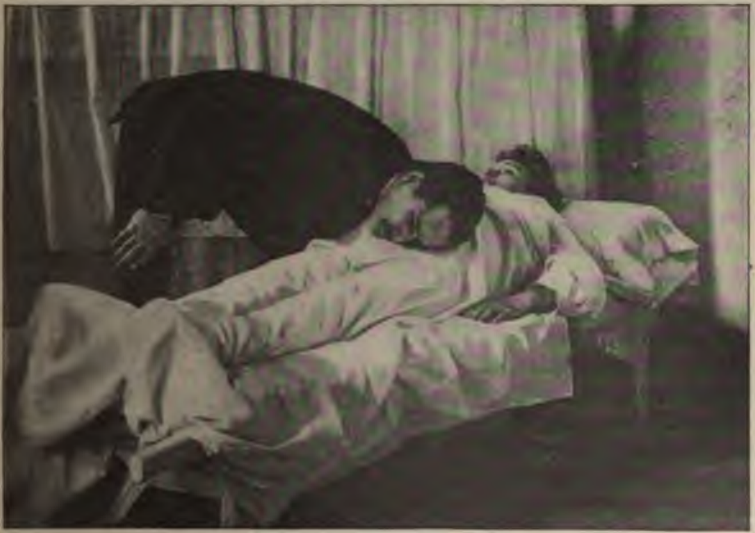
The date at which the heart may be heard is a little after mid-preg-

FIG. 135.



Defective method of listening to fœtal heart; the neck is bent, the middle ear congested. Examination is here shown on the low cot, as it corresponds to the bed or sofa in private practice.

FIG. 136.

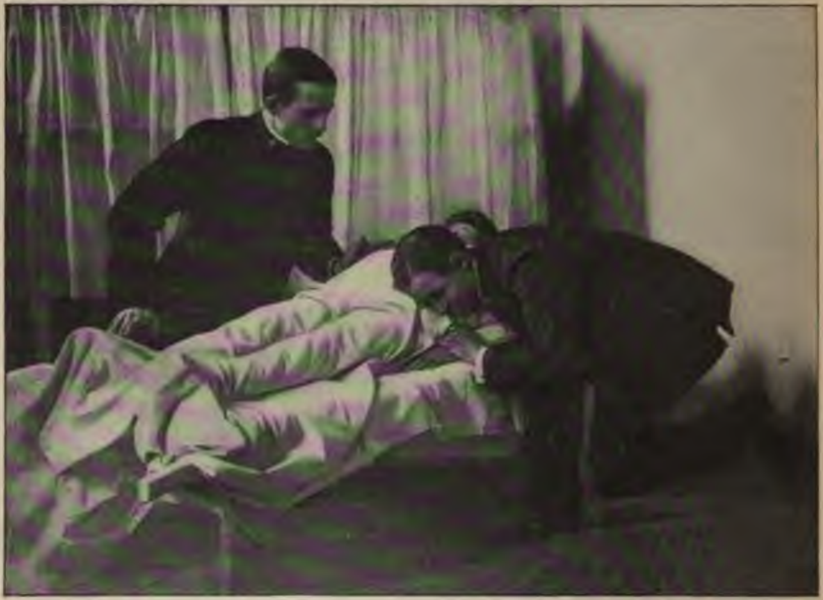


Defective method of listening for the fœtal heart by standing and leaning over. The fulness of the cerebral vessels caused by this position is indicated in the distended veins on the forehead.

nancy; the time is somewhat dependent on the skill of the observer. It is said to be audible in some cases as early as the fifteenth or sixteenth week.

In value, no sign compares with this. It is certain. The chief fallacy lies in mistaking for it the aortic pulsation transmitted through the uterine mass, or arterial pulsation on its surface, or the sound of the maternal heart. A finger on the radial of the mother establishes the connection with her heart, or the reverse. Moreover, a transmitted maternal cardiac impulse grows stronger in tone as the ear works upward toward her chest. Occasionally one finds that he is listening to the pulse in his own ears. The only troublesome uncertainty will occur when the mother's heart is acting excitedly at about the same rate as that of the child, as after long labor or hemorrhage.

FIG. 137.



Better position for listening to the fœtal heart; straight neck, easy posture, fingers on radial. The assistant presses on the fundus.

The heart is rendered faint or inaudible by an occipito-posterior position, a very fat abdominal wall, excess of liquor amnii, anterior attachment of the placenta, by loudness of the uterine souffle, or persistent noise of gas in the bowels. Death of the child does away with this sound, of course; but repeated observations of such absence may be necessary for positive diagnosis, together with default of movements, lack of tone in uterine wall and breasts, and the recession of other signs.

Method of Examination. Prepared as described on page 131, the patient is to lie preferably where she is accessible on both sides, as on a table or couch. The stethoscope is used for early or difficult cases; but on this yielding surface many observers find that more can be accomplished with the ear. It is expedient to train the ear, for one does not carry a stethoscope in an obstetric bag, and the most important facts obtainable from fœtal heart-sounds are those gotten in the systematic examinations during the progress of the labor, namely, concerning the danger to the fœtus or the need of prompt interference. A single unstarched thickness is not a hinderance to auscultation, as a rule. If the listener stands and bends over, or if his collar presses against the jugular vein, congestion of the inner ear will interfere with fine hearing. To hear best, if standing on the left of the patient (or with a better right ear), one kneels at the edge of the bed near the patient's shoulder, facing toward her feet. The right ear is laid rather firmly against the lower abdomen, compressing the fat layers. To auscultate the right side one may kneel opposite the hips and reach across the patient at right angles, or pass to the other side. A relatively long count is desirable—say, thirty seconds—and should gaps occur in the succession of the sounds, one counts steadily across them at the same rate. A hand placed on the fundus, pressing toward the pelvis, will arch the child's back up toward the listener's ear. Patience, and persistence, and favorable conditions are all requisite at times, while a room without a clock and away from street and house noises may be necessary.

Apart from our subject, the fœtal heart has great value in the determination of presentation and position; of plural pregnancy; in deciding whether the fœtus is alive or dead; as a danger signal in labor, a rate persisting below 100 or near 200 calling for interference to save the child.

Uterine Souffle. A murmur synchronous with the mother's pulse is heard along the left side of the uterus. It resembles the bruit in the neck of anæmic girls, and the sound is of a quality entirely unlike the tap of the fœtal heart. If the hand is laid in an arch over the ear and its back lightly brushed with the finger-tip, a semblance of this murmur may be had. Its source is the blood-rush in the enlarged and tortuous uterine vessels; it is usually heard loudest, therefore, along the sides of the uterus, and particularly along that side, the left, which is turned toward the anterior abdominal wall. Here the stethoscope serves best, as the murmur is first hunted for in the sulcus above the middle of Poupart's ligament, and from that point upward, with rather firm pressure. The murmur is heard earliest in the middle line. Late in pregnancy it may be found all over the uterus; though often it is entirely wanting, or, more commonly, is capricious, appearing and disappearing, being strongest during the early part of a contraction. It grows louder as pregnancy advances, and is most marked in anæmic women.

The uterine murmur becomes audible during the fourth month. It persists after the delivery of the placenta. It is a valuable sign of an enlarging uterus, but lessened in importance as proof of pregnancy by its presence with large uterine fibroids, or even in association with ovarian cysts or chronic metritis.

Funic Souffle. The umbilical murmur is synchronous with the fœtal heart, and heard usually over the child's back. It is produced by tension, pressure on and displacement of the cord, originating, as a rule, in the umbilical vein (Winckel). In some cases it may originate in the heart itself—even in an endocarditis (Bumm). The sound is heard more frequently when the cord is coiled about the fœtus, when the cord is abnormally short or long, or when it is deformed—*e. g.*, when the insertion is velamentous. Hence, this bruit furnishes an index of a certain amount of danger to the child, according to Winckel. It is heard after mid-pregnancy, but is relatively rare in the writer's experience.

Fœtal Shock. In listening with the stethoscope as early as the third or fourth month (fourteenth to sixteenth week) the trained ear may sometimes get the tiny thud, with the sound that accompanies it, produced by fœtal impact. The tap of the finger on the back of the hand held near, but not in contact with, the ear, is not unlike it. Winckel says it occurs in 10 to 15 per cent. of all cases. Gas moving distantly in the bowel somewhat resembles it.

IV. PELVIC SIGNS.

By vaginal and abdomino-vaginal examination the chief indications of pregnancy are: Purplish hue; softened cervix; compressible isthmus; bulging, elastic corpus; vaginal ballottement; fœtal parts.

Method of Examination. The details concerning loosened clothing, coverings, and the dorsal posture, with elevated head and shoulders, have been given on page 133. Just before lying down the patient is requested to urinate. When an early diagnosis is urgently desired, and the rectum is loaded, an enema may be given; or if the bowels are much distended with gas a second examination is asked for, and a three-day diet, mostly of meat, fish, eggs, and milk, is ordered, together with a laxative, and, perhaps, a tablet containing charcoal, pancreatin, bismuth, and ginger. To lift the small intestine out of the pelvis and secure access to the rear of the uterus, particularly in retropositions, the injection of air into the rectum with the patient in the knee-chest or latero-prone posture is worthy of trial (Kelly). Nitrous oxide or chloroform are final resorts. By all these means tension is lessened and the reach down into the pelvis facilitated without some of the harsh methods originally counselled by Hegar.

In order to put the muscles of the pelvic floor and those of the abdominal wall, as well as the adductors, at a disadvantage, the patient is brought down to within a foot of the near edge of the table, the feet placed eight or ten inches apart, and the knees spread abroad to their utmost. If a bed is used it should be firm, that the buttocks may not sink into it. The patient lies at a right angle with its length. Five minutes' scrubbing of the hands should be a routine preliminary to vaginal examination, because of the special susceptibility of the gravid woman to infection, because the finger may need to explore within the cervix, and because, if premature interruption of the pregnancy should soon occur one might have infected his patient. The vulva is cleansed. One passes the finger in by sight in order to make no unnecessary contacts, especially with an imperfectly cleansed anal region; the left hand draws the labia wide apart so that the first contact of the examining finger or fingers will be with the hymen or the vaginal wall inside it. Here again, by gentle firmness, a long reach is practicable, the web between the fingers carrying the perineal body far backward and inward.

If possible, the uterus is gently and quickly caught between the two hands and examined. If out of easy bimanual reach, the finger tips are slipped beyond the cervix and hooked forward, lifting the uterus bodily toward the anterior abdominal wall through the intervening intestinal coils. The outer hand depresses the hypogastrium to reach low down on the back of the uterus, or gently makes circling massage movements with gradually increasing pressure as the muscles yield. The patient is told to cough or breathe deeply, or her attention is side-tracked by a question. In these ways, quickly tried, the hands, one on each face of the uterus, reach as far toward the cervix as may be. Beginning at the cylindrical neck, the anterior and posterior surfaces are examined from cervix to fundus, for compressibility just above the cervix, next for bulging of the walls of the body, following the profile and estimating any increase in thickness of it, determining at the same moment its consistency, whether resiliency is present or not, and, lastly, swinging the body from side to side over the stationary inner fingers to appreciate breadth and the denser spot. The cervix should be palpated at first no more than is necessary in order to identify it, for manipulation here quickly induces intermittent contractions, whereby the organ hardens and some of the signs disappear. As an alternative, the uterus may be toppled over backward and the thinned isthmus brought between the fingers of the two hands.

Whenever the fundus lies in the sacral hollow and cannot be swung forward, a tenaculum hooked into the cervix will draw down the uterus within reach of vagino-abdominal or recto-abdominal palpation.

Inspection of the cervix for color-changes, with the speculum, is next in order. A miscarriage subsequent to a speculum examination may be attributed by the patient to the physician's "instruments" either through ignorance or by a woman who afterward induces abortion. With certain patients one avoids any examination except the bimanual, which can do no harm.

Rectal examination gives little information in normal cases, but is necessary in uterine or ovarian displacement, or to outline and differentiate tumors, exudates, or hemorrhages.

Purplish Hue of the Vagina. Venous congestion from hypertrophy of the vessels runs up the entire vagina. On drawing the vulva open the dusky discoloration is seen readily on the anterior vaginal wall below the urinary meatus. A faint venous color may show itself by the end of the first month. Chadwick showed that 80 per cent. of pregnant women developed the color by the end of the third month. The fallacy is that heart disease, varicose enlargement, and the like may produce analogous coloring. Late in pregnancy the pudenda are relaxed, soft, and swollen, while moistened by free secretion of mucus.

Purplish Hue of the Cervix. "A more or less marked lividity of the vaginal portion of the cervix may be observed almost from the first month after conception. The purplish color of the cervix is not only developed earlier, but is more constantly present than that of the vagina" (Jewett).

Enlarged arteries are felt pulsating in the vagina, often suggestive of fœtal movements or ballottement.

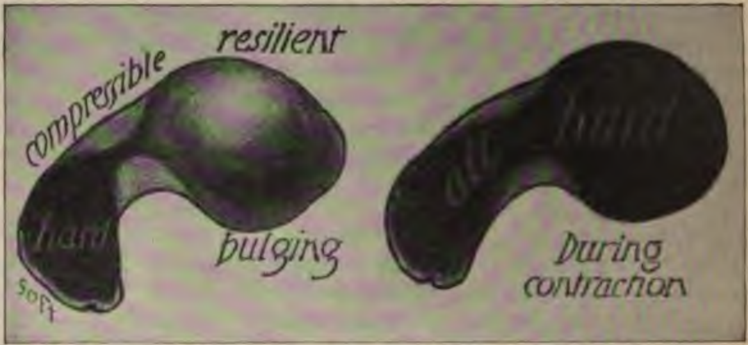
Early Changes in the Uterus. Six or eight weeks after the beginning of the last menstruation the following conditions are found:

I.	In the isthmus between body and cervix	Compressibility.
II.	In the body of the uterus	Elasticity or doughiness.
III.		Bulging, symmetrical or irregular.
IV.		Density differences between right and left sides.
V.		Furrows or folds.
VI.		Intermittent contractions.
VII.	In the cervix	Softening.
VIII.		Purple hue.

Of these signs, the first three are most valuable; in frequency they rank in the opposite order, namely, bulging, elasticity, compressibility.

COMPRESSIBILITY OF THE LOWER UTERINE SEGMENT. Just above the cervix and between it and the rounded body above there is a striking absence of resistance, the fingers of the examining hands coming together closely. When the sign is fully developed the thickness is no more than that of a visiting-card. In its extreme form the corpus seems like a tumor pedunculated. Often the yielding sensation is partial, yet unmistakable. It is accounted for by reference to the section of Pinard's uterus (Fig. 139), imagining the bulk of this ovum as somewhat less, for the enormously thickened mucosa contains many dilated and irregular blood-sinuses which reach their maximum development at the end of the second month, and the decidua is very pulpy and soft. Well-defined compressibility was found by the writer in two-thirds of a series of fifty cases.[1] Of all the bimanual signs of early pregnancy, this is the most important. It is known as "Hegar's sign."

FIG. 138.



Changes in the pregnant uterus of the sixth week, on the left when partly relaxed, on the right when contracted. Diagrammatic side view.

BULGING OF THE CORPUS UTERI, SYMMETRICAL OR IRREGULAR. On the front or back of the uterine body a generally rounded prominence is detected, resembling the blunt end of a hen's egg, but overhanging the retreating lower uterine segment very distinctly.[2] When in front the profile is that of a full-breasted, corsetted woman bending forward. This rounded cornice, or overhanging, may project in any direction or in all directions. No change of early pregnancy is more constant than this.

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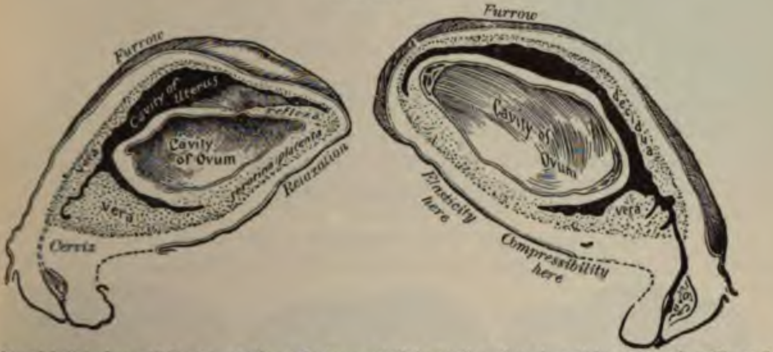
[1] The Editor of this System taught this sign to the writer long before Hegar's assistants published it. Jewett, Therapeutic Gazette, July 15, 1891.

[2] Grandin first insisted on this sign; N. Y. Med. Record, 1886, p. 241.

The other form of prominence is lop-sided. A circumscribed portion, such as half the uterine body, or one horn, or one side near the cervix, is rounded and protruding. The protuberance will constitute the elastic portion, cut off by a groove from the flatter, thinner, denser part.[1]

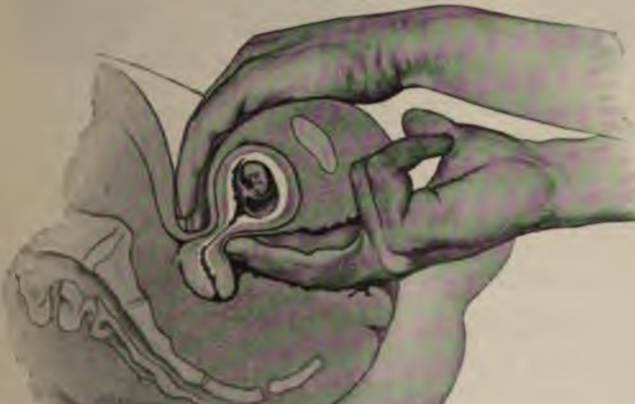
FIG. 139.



Right and left halves of frozen section of uterus at 2½ months, showing thin, relaxed walls and thick decidua. (PINARD.)

Owing to the presence of INTERMITTENT CONTRACTIONS the signs to be found in a given uterus are subject to some variations. During relaxation the body of the organ is either soft, compressible, and flattened, or else doughy. As contraction comes on the body becomes elastic to the touch and more globular; while at the height of the con-

FIG. 140.



Bimanual examination for compressibility of the isthmus at the sixth week.

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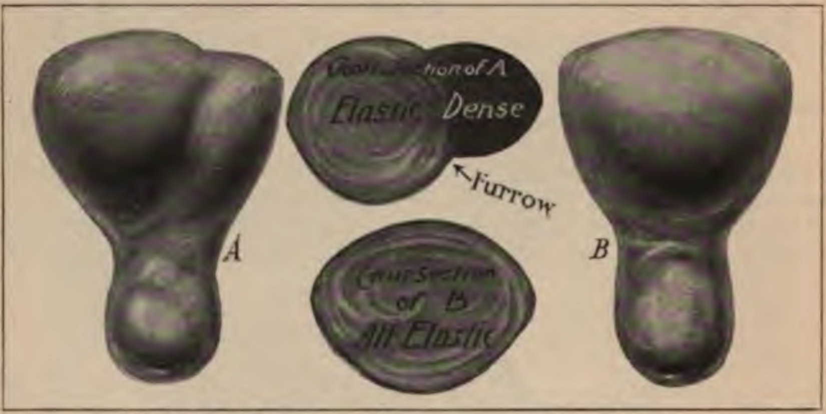
[1] Dickinson pictured this in 1893, in the N. Y. Jour. Gyn. and Obst. Braun-Ferwald (Wiener klin. Wochenschr., 9 März, 1899, and Monatsch. f. Geb. u. Gyn., May, 1899), and Piskaček (Wien, Braumüller, 1899, Ueber Asladungen umschriebenergebärmutter-Abschnitte) have elaborated these findings.

traction the whole body is rigid and hard. The change from one of these conditions to the other may take place under the finger. (Fig. 138.)

ELASTICITY. If the empty uterus were always as hard as a raw potato, and the gravid uterus elastic as a rubber ball, a diagnosis of early pregnancy would be easy. Unhappily the conditions are not so simple. The corpus uteri of gestation, when of typical consistency, is resilient, distinctly suggesting "the fluid elasticity of the growing ovum" within. In this condition one most frequently finds it, and the finding constitutes one of the most easily determined and most valuable of the early signs.

DENSITY DIFFERENCES BETWEEN RIGHT AND LEFT SIDES. In a certain percentage of uteri of early pregnancy one portion of the body is dense, hard, or resisting, and the remainder, usually the larger portion, is elastic. (Fig. 141.) Between these two parts an upright or oblique or crescentic furrow runs as a clean-cut boundary. These characters may temporarily disappear during a contraction.

FIG. 141.



Front views of uteri six weeks pregnant, showing two common types.

A. Prominence and elasticity on one side, density toward the other horn, with a furrow between.
B. Bulging and elasticity symmetrical and anterior.

FURROWS OR FOLDS. Grooves, long or short, straight or curved, may run across the front or back of the corpus or fundus. A double groove will define a fold, and the fold may be hard on top, constituting a ridge. Folds and grooves run longitudinally or obliquely more often than across.[1]

SIZE. The increase is fairly regular, and may be determined by comparison of findings three weeks apart. Unhappily the finger has not a memory of that duration. Increase in length up to the sixth or even the eighth week is very difficult to estimate. But with the increase in thickness it is different, since the antero-posterior dimension of the corpus is readily palpated, and expansion is appreciable at the sixth or eighth week, as the body then measures 2 inches (5 cm.) from front to back. At the end of the third month the organ is 5 inches (12.5 cm.) in length, 4 inches wide (11 cm.), and 3 inches thick (8 cm.); that is, about the size of a man's fist tightly closed.

[1] Dickinson (N. Y. Jour. Gyn. and Obst., June, 1892), confirmed by Hegar (Deutsche med. Wochenschr., 1895, No. 35).

The date of appearance of the signs that are determined by conjoined manipulation is the sixth week on an average; but practice enables one to find them in favorable cases as early as the third or fourth. At the eighth week they ought to be distinct. Later the ovum fills the cavity more and more completely, and compressibility is lost after the third month. The asymmetries of growth and density may persist to the fifth month.

SOFTENING OF THE CERVIX. After the first month the consistency of the cervix changes. First a velvety feel like that of the mucous lining of the cheek is noted, covering the hard knob beneath. The softening progresses upward rather slowly until the sixth month. At the eighth month the whole cervix has become yielding, so that the finger passes through the canal without resistance. Indeed, at term there seems to be no projection, the cervix having the same consistency as the vaginal wall.

"A similar softening occurring from pathological causes lacks the same progressive character." Conversely, a hard cervix and especially a small firm cervix rules out a supposed late pregnancy, and thus, in the differential diagnosis of obscure abdominal tumors, becomes a factor of no mean value.

The POSSIBILITIES OF ERROR connected with the early signs are as follows:

In the non-gravid or virgin uterus somewhat similar conditions may be found by skilled touch when a complete examination is rendered easy by an abdominal wall that is thin and relaxed in a patient free from sensitiveness. Considered in profile, the anterior surface of the virgin uterus is approximately flat or slightly rounded, whereas the posterior face shows a distinct convexity. During the intermittent contractions that can be appreciated by palpation in many uteri in the unimpregnated state a more globular form and a hardening of the whole uterine body develop, the antero-posterior diameters especially increasing.[1] These vacillations in consistency have, however, but a short range, elasticity and bogginess of the body being infrequent, and thinning at the lower segment absent (except in some anteflexions). Asymmetry, or partial division of the corpus into sections or chambers by a palpable furrow, or into ridges, while it is not uncommon in the non-parous uterus, presents no striking contrast of consistency between the right and left sides. Softness of the cervix due to œdema alone, or the dusky hue due to erotic feeling, are not accompanied by some of the other pregnancy signs.

Anteflexion with atrophy of the junction of cervix and body will yield the hour-glass isthmus with a body rounding out above the thinned angle. Here the smallness of the body, together with its hardness, must exclude pregnancy, as well as the lack of increase in size or elasticity proved by an examination two or three weeks later. Hyperæmia, hyperplasia, or subinvolution will exhibit an enlarged body; but the history and symptoms of chronic uterine disease, the resistance to the touch, and the absence of Hegar's sign, in conjunction with the stationary character of the findings, will exclude pregnancy. Retroversion with flexion will present swollen conditions resembling the alterations of pregnancy. Reposition—and consequent shrinkage—may be necessary before the diagnosis can be settled. A soft submucous fibroid causes hemorrhage rather than amenorrhœa.

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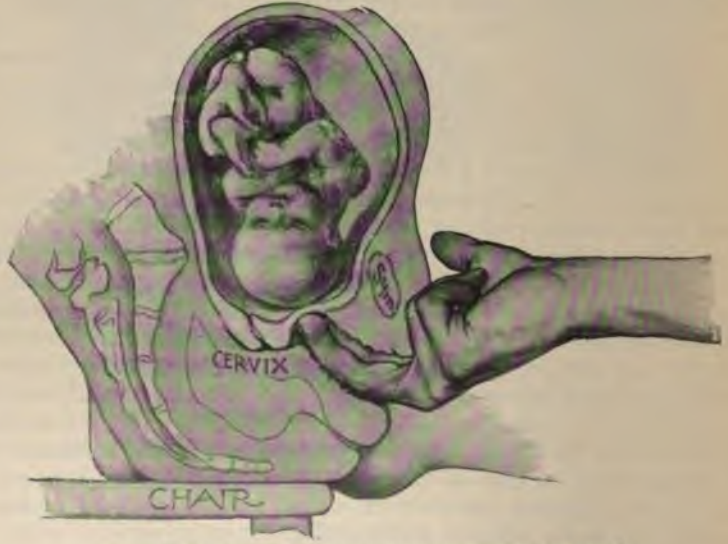
[1] Lindblom, Archiv f. Gyn., Jan., 1892; Acconci, Turin, 1881, epitome in Centralblatt f. Gyn., 1892, No. 8.

Internal Ballottement. One or two fingers against the anterior vaginal wall close to the cervix give a sudden impulse to that part of the fœtus resting against the anterior uterine wall. The child floats up through the liquor amnii, and after a slight and momentary excursion settles back against the finger-tips, repercussing with a very gentle tap. The departure alone, without evident return, is enough to constitute this sign. In order to develop it the long axis of the uterus should be vertical, and this is brought about by a posture half-way between sitting and lying down, on the edge of a bed or table.

The value of the sign is very great, but there are others that develop much earlier that are of greater import. It is detected when the child is large enough to impart sensation to the finger, and ceases when the bulk of the fœtus too nearly fills the cavity, being present, then, during the fifth and sixth months (twenty-one to twenty-six weeks). The fœtus is too light before this time, and there is too little fluid later. Ballottement is absent with scanty liquor amnii, with twins, and with the placenta low in front.

The possible but infrequent fallacies in ballottement are an anteflexed uterus, a pedunculated cyst or fibroid, internal projections of large cysts, vesical calculus with the bladder full, a kidney floating low, pulsation of the uterine artery (Jewett).

FIG. 142.



Internal ballottement, semi-recumbent posture, at sixth month.

Fœtal parts may be felt through the vaginal and uterine walls by the twentieth week (fifth month, or earlier); the head or breech made out by the twenty-eighth week (six and one-half calendar months), and reached directly through the cervix during the seventh month (Winckel).

PREGNANCY—THE SIGNS BY MONTHS.

Weeks.	Lunar Months.	Calendar Months.	History.	Mammary.	Abdominal.	Pelvic.
1 2 3 4	1	1	**Suppression of menses** (throughout).			
5 6 7 8 9	2	2	**Nausea.**	**Size—nodules.** **Veins.** **Primary areola,** pigment, follicles, corrugation.		**Uterine body bulging,—elastic or doughy; isthmus compressible; cervix softening.**
10 11 12 13	3	3	**Nausea.**	All, throughout pregnancy. **Milk.**		As before. **Purplish hue.**
14 15 16 17	4	4	Nausea passes.		**Fundus rises.** Fœtal shock.	Cervix softens progressively. Compressibility lost. **Fœtal parts.**
18 19 20 21 22	5	5	**Quickening** (4½ *months*).	**Secondary areola.**	Pigmentation. **Intermittent contractions.** **Fœtal parts.** **Fœtal heart.** **Uterine souffle.** Funic souffle.	**Internal ballottement.**
23 24 25 26	6 7	6		All, throughout.	**Fœtal movements.** **External ballottement.** Fundus at navel. Striæ.	**Internal ballottement.**
27 28 29 30	8	7			All, throughout.	Ballottement lost. Cervix patulous, pulpy.
31 32 33 34 35	9	8				
36 37 38 39 40	10	9				

DIFFERENTIAL DIAGNOSIS OF PREGNANCY.

In the early months:

Anteflexion of the uterus with atrophy of the angle and hyperæmia of the body may closely counterfeit the organ six weeks pregnant. The peculiar elasticity of the corpus uteri and its ready variations from relaxation to firm contraction are missing, while the persistence of menstruation, even though scanty, as well as the stationary character of the findings, as shown at a later examination, will make the distinction.

A pedunculated fibroid of the anterior uterine wall is solid, and, therefore, unlike the corpus of pregnancy in consistency.

An ovarian cyst or a distended *tube* in the cul-de-sac may suggest retroversion of a gravid uterus, especially if moving with the cervix. Their tension and clear elasticity are stable, and more marked than those of the ovum-filled corpus.

Chronic metritis and subinvolution, on the other hand, impart to the finger a firmer resistance, and not a globular shape nor bellying in the antero-posterior diameter, nor do they show compressibility of the isthmus.

In retroflexion the swollen uterus may resemble the gravid organ of the fifth or sixth week, and not until after reposition and shrinkage may the difference be apparent.

The diagnosis of tubal gestation is fully treated of in the chapter on Ectopic Gestation.

In all these conditions experience, expertness, and access to all parts of the pelvis in order to map out the organs may, possibly, be necessary for a diagnosis. A dubious history, and sensitiveness, and resistance may call for repeated examinations or for anæsthesia. One mistake in five, or many blanks, are conclusions to be expected.

In the later months:

General Rule in Differentiating. Three discrepancies are always to be borne in mind as pointing to conditions other than pregnancy:

1. The rate of enlargement differs from that of the pregnant uterus.
2. The size and the period of amenorrhœa do not correspond with each other.
3. The most important signs of pregnancy are absent, namely, fœtal heart, fœtal movements, distinctive fœtal parts, and the external and internal ballottement. Menstruation usually persists. With each of the following disorders it will not, therefore, be necessary to reiterate the above statements.

Fat. The general rotundity of the patient arouses suspicion, while locally the thickness of the deposit may be estimated by lifting a fold or seizing the bulk of the belly-wall between the hands. The whole surface is faintly resonant on percussion. Abdomino-vaginal exploration fails to bring an organ between the two hands, through which any thrust may be transmitted, and the small, hard cervix gives a clue to the size of the uterus. Obesity is a frequent cause of amenorrhœa or scanty flow, and especially when anæmia coexists.

Tympanites. Here the girth is variable from time to time, the resonance is general and obvious, and a firm tumor is lacking. With steady pressure while the patient coughs or breathes deeply, a deeper and deeper reach sinks the hand toward the spinal column. Again, the cervix has not softened to tally with the bigness of the abdomen.

Ascites. The shape is suggestive, being not prominent, but rather flat in front and bulging on the sides, as the patient lies. Percussion brings out tympany in front and flatness or dulness at the flanks, the level of the flatness changing with changes of posture. In pregnancy it is a curiosity to find any intestinal coils in front of the uterus when the fundus has once risen well out of the pelvis. Suppression of the menses is often seen in dropsy, and the history of disease of the heart, kidney, or liver will indicate the cause.

Ovarian Cyst. In its earlier stages the resistance is most marked at one side of the median line; later it may be central, but this will be after long growth; a monocyst is more smooth, globular, and elastic than the uterus, and fluctuates all over. The most important point lies in the characteristic cyst-sensation imparted to the hands. The uterus, and with it the cervix, is displaced toward the back, side, or to the front, as a finger, following upward from the small, firm external os may be able to ascertain, though the distinction is often most difficult. In the presence of a moderately long pedicle there may be a space between uterus and cyst into which the fingers can press. The gravid organ of the fourth month, rotund, firm, without movements, fœtal parts, or heart-sounds, and with the cervix far back, where it cannot easily be traced as a connection of the mass above, most nearly resembles a cyst which has crowded the womb backward. But the cervix of pregnancy at this stage is boggy on its surface, is usually to be found in the median line, and may be followed up laterally into the body. This body and its changes in consistence are to be studied, the round ligaments located, if possible, and notes made for comparison three or four weeks later. The tension of hydramnion is suggestive of a cyst. Cyst and gestation may exist together and render the diagnosis difficult. Amenorrhœa is not often present in ovarian growths, and the patient has commonly a history of increasing dysmenorrhœa.

Fibroid Tumors. Most growths of this kind are very hard. Some are nodular, and occasionally one bears a likeness to fœtal parts. Careful palpation and bimanual examination must map out the relation between the unsoftened cervix and the tumor or tumors in or on the uterus above. A study of the location of the round ligaments may demonstrate the common asymmetry of enlargement due to fibromata, as compared with the usual symmetry of pregnancy. Instead of cessation of menstruation, uterine hemorrhage is the rule, either periodic or continuous, and if anæmia stops the flow, the arrest is gradual and not sudden. Occasionally the new growth is subperitoneal and pedunculated, or the cervix may be gaping to give exit to a submucous fibroid. When fibromata and pregnancy coexist the tumors grow rapidly, particularly the intramural variety, and the combination adds to the difficulty of the diagnosis. Unless the tumor is very large and low, the purplish hue of the vagina and cervix is not developed in these growths as in pregnancy. In difficult cases, again, the final appeal is to time or to chloroform.

Enlarged Organs. These develop from above downward. The dulness, the line of the lower edge, and the resonant strip below serve to indicate the source of the abdomen's prominence. Encysted dropsy is rare. Wandering organs, like the kidney and spleen, can be pushed upward. Malignant omental and mesenteric growths are lumpy and fixed, presenting, if large, a marked cachexia late in life.

An over-distended bladder gives a history of short duration, pain, and dribbling. Retroversion, with or without pregnancy, is often its associate. The catheter settles the diagnosis.

Phantom Tumor. In spurious pregnancy, breast changes, the size of the abdomen enlarged with gas and fat, and the imaginary movements have led hysterical and anæmic individuals and women near the menopause or excessively anxious for children into curious errors. The uterus is found to be small, and chloroform may be needed to assure the family of the self-deception.

Hæmatometra. A growth characterized by monthly increase in size, accompanied with severe pains and contractions before the appearance of menstruation at puberty, points to an atresia somewhere between the hymen and cervix. It is very rare. More rarely still the canal may have closed up from injury or disease.

CHAPTER V.

DURATION OF PREGNANCY.—EVIDENCE OF PREVIOUS PREGNANCY.

The Duration of Pregnancy.

No definite statement can be made of the typical normal length of the period of gestation. Variations in the apparent duration of pregnancy occur in animals, in which calculations have been made from the date of a single coitus. When impregnation occurs in the human female after a single coitus, the date of which has been accurately known, as in single women, or in married women whose husbands have been absent for months, the average period between the fruitful congress and labor is two hundred and seventy-three days. But calculations can rarely be based on a single coitus. Even when it is possible to compute from one coitus, the period intervening between the fruitful coitus and labor varies in different women, and in the same woman in different pregnancies. This is explained by several possible causes. The interval between insemination and fertilization is not constant. We have no exact knowledge of the length of time during which the respective sexual elements, the ova and the spermatozoa, may retain their vitality in the maternal passages. From the data at present known, it is assumed that the time of fecundation may vary from a few days to a week or more after insemination. Again, gestation may be prolonged beyond the usual normal period, or may fall short of it. The precise duration of pregnancy cannot, therefore, be definitely determined.

Should impregnation occur within the first few days following the menstrual period, the catamenial flow is almost certain to be absent at the next menstrual date; when impregnation takes place shortly before an expected period, a partial menstruation may follow at the menstrual epoch, but more or less atypical in character. The probable date of labor as computed from the last menses becomes still more uncertain in women whose history is one of menstrual irregularity.

Whether or not a woman can give birth to a child ten months or more after the last coitus is a medico-legal question on which the obstetrician may be called upon to testify. The French law recognizes the legitimacy of the offspring when the apparent term of gestation is within 300 days. In Austria the recognized duration of pregnancy is from 240 to 307 days. In England and the United States there are no legal limits, but the possible protraction of gestation is admitted by all legal authority. Taylor and Beck, in their works on *Medical Jurisprudence*, cite numerous instances of protracted gestation. Several cases are recorded by obstetric writers in which pregnancy was believed to have continued 319, 324, 332, and 336 days respectively after the last menstruation. Dewees cites a case which continued for ten calendar months. Playfair, Lusk, and Leishman have all mentioned instances of considerable prolongation.

Most frequently in such instances the child is a male and of large size. Some women appear always to exceed the usual limits of pregnancy.

Prediction of the Date of Labor.

(*a*) **Naegele's Rule** for the prediction of the date of labor is based upon the fact that the average interval between the beginning of the last menstruation and the occurrence of labor is two hundred and eighty days. It consists in counting forward nine calendar months from the beginning of the last menstruation and adding seven days. This is a ready method of computing approximately two hundred and eighty days from the beginning of the last menstrual period. The same result is gained by counting backward three months and then adding seven days. The prediction is usually accurate within a week. An error of two or three weeks, however, is possible, since in exceptional instances pregnancy may begin at any period between the menstrual epochs.

(*b*) **Reckoning from the Date of Quickening.** It is a common popular custom to estimate the date of parturition from the time of quickening, counting this sign as occurring in mid-pregnancy. But as the period of quickening varies from the twelfth to the twentieth week, and the observations of the patient are always liable to error, the method is obviously unreliable. When, however, accurate menstrual data are not available, or when pregnancy has occurred in the absence or temporary suspension of the menstrual function, reckoning from the period of quickening may serve for an approximate estimate.

(*c*) **Mensuration of the Uterus** is not wholly reliable for this purpose, since the amount of liquor amnii varies in different cases, and the size of the fœtus is not always the same in different instances for the same period of gestation. Moreover, more than one fœtus may be present. The situation of the fundus cannot be depended upon for determining the stage of gestation, for the reasons just stated under mensuration of the uterus. The height of the fundus, too, is influenced by the tonicity of the abdominal walls, by the capacity of the pelvis, and by the direction of the uterine axis. Again, in comparing the situation of the fundus with that of the umbilicus, it must be remembered that the umbilicus is not altogether a fixed point.

(*e*) **Mensuration of the Fœtus.** The length of the fœtus is about double that of the fœtal ovoid. The length of the fœtal ellipsoid may be measured with approximate accuracy through the abdominal wall, by placing the poles of a pelvimeter on the abdominal wall, one opposite each extremity of the fœtal ovoid. The measurement may be taken more accurately by placing one pole of the pelvimeter on the abdomen over the upper extremity of the fœtal mass and passing the other pole through the cervix and holding it against the presenting part; but this method is obviously objectionable and should be reserved for emergencies. The rate of fœtal development, however, is not uniform. Nevertheless, measurements of the fœtus, including the accessible diameter of the head, afford fairly reliable data for predicting the date of labor.

The approximate lengths of the fœtus in the last four months of intra-uterine development respectively are stated in the following table:

LENGTH OF THE FŒTUS.

Sixth calendar month, 30 to 35 cm., about 12 to 14 inches.
Seventh calendar month, 35 to 40 cm., about 14 to 16 inches.
Eighth calendar month, 40 to 45 cm., about 16 to 18 inches.
Ninth calendar month, 45 to 50 cm., about 18 to 20 inches.

Evidence of Previous Pregnancy.

Evidence of a previous pregnancy which had occurred at any remote period, and which had continued but a few months is difficult or impossible of recognition. Within a few days following the expulsion of its contents, the uterus will be found more or less enlarged and the cervix more than normally open. It may be difficult of distinction, however, from an enlarged and menstruating uterus. Soon after an abortion remnants of the fœtal structures may be looked for—microscopically—in the products of a curettage or in the lochial discharge.

The physical evidences of a previous pregnancy are much more distinctly marked after recent parturition at or near term. The fundus uteri will then be found in the hypogastric region, much enlarged, and the cervix will be patulous. For several days after labor the genital discharge corresponds in quantity and character to the lochial flow. Fresh lacerations of the cervix may be detected. The vaginal portion of the cervix is more nearly cylindrical in the parous than in the nulliparous woman, and its lower border is more or less deeply notched. Relaxation of the vagina persists for some time after delivery. The fourchette is usually, and the hymen is always, destroyed in the first labor.

The abdominal walls are soft and relaxed, with the skin thrown into folds, and its lower half is marked with white, shining lines (*lineæ albicantes*).

The breasts are tumid and contain lacteal secretion. The presence of colostrum corpuscles in the breast secretion indicates a recent delivery. The characteristic areolæ of pregnancy are in great degree permanent, and they afford, therefore, no diagnostic evidence. On the faces of pregnant women frequently there may be seen the chloasma uterinum, which sometimes lasts years after parturition. Menstrual and uterine disorders, however, may cause the same skin affection in women who have never been pregnant.

The general appearance of the woman, even after recent delivery, usually presents nothing characteristic.

After death the recognition of the parous condition is not difficult. The cervical canal has lost its fusiform shape; the uterus is enlarged and heavier; the corporeal cavity is approximately oval, the inner surface of the fundus uteri being no longer convex, as in nulliparæ, but flat or even concave.

CHAPTER VI.

HYGIENE AND MANAGEMENT OF PREGNANCY.

IT is the duty of the practitioner of medicine engaged to attend a woman in confinement to give her such hygienic instruction as she may require and to extend a certain degree of professional attention throughout pregnancy. Many disorders and complications are likely to arise during gestation, and the woman's welfare may depend in no small degree upon the watchful care of her medical adviser.

Diet. Early in pregnancy some degree of digestive disturbance and loss of appetite is the rule. By the fourth month the gastric irritability usually begins to abate and appetite and digestion improve. In the regulation of diet reasonable regard should be had for the preferences of the patient. Individual fancies, dislikes, or idiosyncrasies must be consulted. In this way the morning sickness may sometimes be managed satisfactorily. By taking digestible light nourishment between meals one may often control the nausea due to the emptiness brought about by rapid absorption to meet the increased demand. Most foods, animal and vegetable, which are nutritious and easily digestible, are suitable. In short, the diet during pregnancy should be plain, simple, digestible, highly nutritious, and be taken at regular intervals. No invariable rule can be laid down for all cases, as the same foods do not agree equally well with all patients. A sufficiently liberal diet contributes to improve hæmatosis, increases functional activity, augments body-weight, gives a healthy tone to the bloodvessels and tissues, and diminishes the susceptibility of the nervous system to pain and to reflex irritation. A suitable diet, too, during pregnancy is obviously essential to the normal development of the fœtus *in utero*.

Excessive eating, on the other hand, must be avoided. The toxæmia of pregnancy is often the result of overfeeding. Especially in the later weeks of pregnancy, when the gravid uterus exercises pressure upon the stomach, food should be taken in small quantities. Too liberal diet at this time may result in overdevelopment of the fœtus. *Per contra*, a restricted diet during the last six weeks of pregnancy, with limitation of sugars and of starchy foods, it is claimed tends to lessen the size and hardness of the child's head and to facilitate the birth (Prochownik).

The subject of digestive disturbances is fully treated on page 387.

Digestive Organs. Usually some attention must be directed to the stomach disturbances. Allusion has already been made to their dietetic management, which is often more efficacious than medicinal treatment. In feeble digestion good results may be expected from the temporary use of koumyss or predigested foods. When the stomach rejects all food resort must be had to rectal alimentation.

It is important that the bowels be evacuated at least once daily. Most women are habitually constipated, and pregnancy commonly aggravates the disorder and intensifies the ill results accruing from incomplete intestinal elimination.

The use of fruits, fresh vegetables, and coarse bread will often accomplish much in relieving constipation. The mineral waters, saline or sulpho-saline, solutions of sodium phosphate or Carlsbad salts answer admirably. Other efficient laxatives are aloin, podophyllin, and cascara sagrada. Rectal enemata should be avoided, and drastic cathartics are always objectionable, owing to the danger of causing abortion. Instances are rare in which purgation is necessary.

Exercise. Moderate muscular exertion, as a rule, is well borne. Daily walks in the open air are useful both for exercise and recreation. Sea-bathing is permissible if properly managed. Most other forms of light and agreeable exercise are beneficial. Cycling may usually be permitted, if practised in moderation and with care to guard against accident. Passive exercise will be found highly salutary to those who cannot bear the more active forms. Carriage-riding affords the necessary fresh air and sunlight. Horseback-riding, carriage-riding over rough roads, lifting, and all violent muscular strain and overwork must be prohibited. Crowded and ill-ventilated rooms should be shunned.

Properly regulated physical exercise is not only essential to the normal progress of gestation, but it doubtless conduces to easy labor. It is especially important in women of delicate health and feeble muscular development.

Rest. The pregnant woman requires an abundance of sleep. Eight hours daily of undisturbed sleep are essential. An hour or two immediately preceding the noon meal may well be added to the usual night's rest.

Clothing. The clothing should be so adjusted as not to exercise undue pressure upon the chest and abdomen. Corsets must be proscribed. Garments suspended around the waist should be as light as is consistent with comfort and health. The heavier clothing should hang from the shoulders. Pressure upon the abdomen impeding the expansion of the growing uterus and its contents, favors the development of a not uncommon complication of pregnancy—albuminuria and uræmia. In multiparæ with lax abdominal walls, relief is often afforded by supporting the lower abdomen with a properly constructed abdominal belt. Such an appliance must be adjusted with care not to increase the pressure upon the pelvic and renal veins. It should exert a lifting rather than a constricting pressure.

Bathing. The functions of the skin should be kept active by frequent bathing during the entire course of pregnancy, and particularly in the later months, when it is important to relieve the kidneys as much as possible of the extra work thrown upon them. Daily baths are advocated, at a temperature suitable to the time of year and the habits of the individual, although it is, perhaps, preferable that the bath be warm at first, and rapidly cooled at the finish. To secure proper reaction the skin should be rubbed briskly with a coarse towel.

Breasts and Nipples. Attention should be given to the breasts and nipples preparatory to lactation and nursing. If they are retracted the patient should be taught to draw them out gently with the thumb and finger, for a few minutes daily, particularly during the last few months of pregnancy. This not only serves to develop them, but it accustoms them to manipulation and lessens the danger of injury by nursing. When a nipple is inverted or deeply creviced the smallest size of cupping-glass topped with a rubber bulb, or a breast-pump, applied a few minutes each day, serves to roll out the depressions, and by toughening the thin epithelial layers at the bottom to prevent fissure and infection when nursing begins. Strict cleanliness is essential. Daily ablutions with cold water are recommended as a prophylactic against fissures during nursing. Daily inunctions with fresh cacao-butter are better than the astringent lotions commonly employed. Friction with gauze to remove the ointment renders thin-skinned nipples less sensitive.

Hygiene of the Pelvic Organs. Vaginal injections are not necessary, except in the presence of a leucorrhœal discharge. If injections are required a saturated solution of boric acid, one or two quarts, may be given with a fountain syringe and with the least possible mechanical violence. The temperature should be that of the body.

Local treatment to a diseased vagina, cervix, and canal may, with proper precautions, be carried out during pregnancy. Pregnancy always aggravates an existing chronic cervical endometritis; it increases the cervical catarrh, the granular degeneration, the secondary vaginitis, and vulvar pruritus. The gentle use of warm vaginal injections and topical applications of mild astringents and emollients, and, in rare cases, of solutions of silver nitrate, may not only improve the local condition, but also aid in controlling reflex disturbances, such as nausea and vomiting.

Sexual Intercourse should be restricted; it is injurious to some pregnant women. Total abstention should be enjoined at the menstrual dates, and especially in women who have previously aborted. It is most likely to be harmful in the early months of pregnancy and again toward the close.

The usual marital relations are distasteful to most women at this time, and to many are the source of much pelvic discomfort, as well as a prominent factor in aggravating the nausea of pregnancy and in the induction of abortion.

Urinary Excretion. It is especially important that careful attention be directed to the performance of the renal function. A chemical and microscopical examination of the urine should be made at least twice monthly during the earlier months and not less than once weekly during the last three months of pregnancy. Close observation of and the careful regulation of the function of the kidneys during gestation are of the utmost importance in the prophylaxis of the toxæmias of pregnancy. The changes liable to occur in the urine of pregnant women have been described in another chapter.

The occurrence of albuminuria should always be regarded with suspicion. Albuminuria always calls for the institution of diet and other remedial measures.

The most valuable evidence of the emunctory activity of the kidneys is the total daily quantity of urinary solids, especially of urea. The total output of urinary solids daily is normally about 1000 grains, and of urea 500 grains. These figures, however, are subject to considerable variation within physiological limits. They are affected by the quantity and quality of food ingested and by the degree of muscular exertion.

The patient should be directed to bring a sample of urine twice a month, to measure an average day's total, and to give notice if it falls below the quantity proper for her weight and the season. Note should be taken frequently not only of the daily quantity of urine passed, but also of its specific gravity. Samples for examination should be had from the entire amount of urine voided during the twenty-four hours. The total daily solids may be estimated approximately by the following method: Multiply the last two figures of the number representing the specific gravity by the number of ounces for the day. The product multiplied by $1\frac{1}{10}$ indicates nearly the number of grains of solid matter in the given number of ounces.

The quantitative determination of urea is best conducted by Bartley's method, as detailed on p. 212.

The Mental Condition of a pregnant woman should always be an object of solicitude. With increased emotional susceptibility she may be quite excitable, irritable, and be easily disturbed by external influences which in the non-pregnant would make no injurious impression.

It is an interesting question to what extent the unborn child is affected by the mental condition of the mother. There is no doubt that her mental state may be the cause of modifications in the physical, the intellectual, and the moral characteristics of her offspring. The mental hygiene of the mother is, therefore, important. She should be guarded from all untoward influences. Kind assurances are helpful, and judicious amusement should be encouraged. Associations should be agreeable, cheerful. A gentle protective care is to be thrown around the patient, and she should be treated with considerate kindness. In the attainment of this desirable environment the co-operation of the friends is obviously essential.

Infectious Exposures. The pregnant woman should be warned of the danger that may come from contact with infectious or contagious disease. Such exposures are doubly dangerous shortly before labor. While pregnancy continues the natural resistance to the specific action of pathogenic germs is undoubtedly increased, but after parturition the exhaustion of labor tends to diminish resistance, and the woman becomes an easier prey to infection. The diseases with which it is most dangerous for her to come in contact are scarlet fever, diphtheria, erysipelas, and all septic conditions.

Avoidance of Drugs. In all cases as little medicine as possible should be administered. Pregnancy as a purely physiological condition is best managed by a close observance of judicious hygienic rules.

Obstetric Examination. After the fœtus is viable it is the duty of the obstetrician to make careful examination by the abdomen. In all cases an external and generally an internal examination should be made toward the last month of pregnancy. The objects of this examination are to determine:

1. Whether or not the woman is actually pregnant.
2. The duration of pregnancy.

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[1] The proper observance of rules of hygiene during pregnancy may be better insured by placing in the hands of the patient a pamphlet or convenient manual briefly setting forth her duties in the matter.

3. Whether the pregnancy is single or multiple.
4. Whether the fœtus is living.
5. The presentation and position of the fœtus.
6. The measurements of the maternal pelvis.
7. The size and hardness of the fœtal head.
8. The possible existence of pelvic or abdominal tumors and of other pathological conditions that may injuriously affect the labor.
9. The probable date of labor.
10. The obstetric prognosis.

In first pregnancies the vaginal examination also determines small size, spasm or rigidity of the vulva; in pluriparæ, old injuries and a possible low seat of the placenta are to be borne in mind.

The precise methods of diagnosis which are carried out in well-managed maternities ought also to be the rule in private practice. Should the conditions be such as may lead to long and difficult labor, the obstetrician should be forewarned, that he may determine in advance what course to pursue: whether to choose the induction of premature labor, to wait till term and depend upon the use of forceps, to resort to podalic version, or symphysiotomy, or a Cæsarean section. The knowledge gained by the proper study of the obstetric case in advance of labor affords the means of saving many maternal and fœtal lives.

The obstetric examination will be treated more in detail in connection with the management of labor.

PART III.

PHYSIOLOGY OF LABOR.

CHAPTER VII.

THE MECHANICAL ELEMENTS OF LABOR.

THREE factors are concerned in the mechanism of labor. They are: 1. The Expelling Powers. 2. The Passages. 3. The Passenger. An intimate knowledge of these elements of the parturient process is the first essential to a proper understanding of the course and management of both normal and abnormal labors.

I. The Expelling Powers.

The expellent forces are three: *a*. The contractions of the uterus. *b*. The action of the abdominal muscles. *c*. The action of the pelvic floor.

(*a*) **The Uterine Contractions.** The chief expelling power is the contraction of the muscular walls of the body of the uterus, or, rather, of the upper uterine segment.

The uterine contractions are *involuntary*, being mainly under control of the sympathetic nervous system. Yet, though independent of the will, they may be strengthened, enfeebled, or wholly arrested by emotional influences. The uterus has two motor centres, one in the medulla oblongata and one in the lumbar portion of the cord; apart from these its contractions are influenced to some extent by the action of its own ganglia. Routh observes that direct communication with the brain is not essential to co-ordinate uterine action, though the brain seems to regulate the pains. Direct communication between the uterus and the lumbar enlargement of the cord is probably essential to co-ordinate contraction.

The contractions are assumed to be *peristaltic*, the wave beginning at the fundus, or at the cornua, and sweeping almost instantaneously over the contractile segment. This peristaltic character of the uterine contraction is marked in the tubular uterus of some of the lower animals, but is inappreciable in the human species.

They are also *intermittent*. At the beginning of labor they recur at intervals of about thirty minutes. The intervals shorten as labor progresses, and at the acme of expulsion they do not usually exceed two or three minutes; frequently at the close of the perineal stage they are practically continuous.

The *duration* of the contraction is about thirty seconds at the onset of labor, and it is gradually lengthened to sixty seconds, or even more, as the expulsive efforts reach their height. Variations in both the frequency and the length of the contraction, however, are subject to some degree of irregularity. The event presents three stages, Contraction, Persistent contraction, Relaxation.

THE STRENGTH OF THE UTERINE CONTRACTION varies in different women. It differs somewhat in the same person at different stages in the progress of labor. Frequently it is observed that each alternate contraction is more powerful than the preceding.

The force of the contraction cannot be definitely stated. According to Duncan, the combined power of the uterine and abdominal muscles may attain a maximum of fifty, or even eighty, pounds; according to Schatz it ranges from seventeen to fifty-five pounds. Poppel, Poullet, and Ribemont have reached conclusions nearly similar to those of Schatz. The estimates of Duncan, Poppel, and Ribemont are based on the force required to rupture the membranes. Schatz measured the downward pressure exerted during a labor pain by means of a species of manometer, but the latter method determines only the force with which the head moves, while the propelling power obviously must equal the sum of the motion and the resistance. Unfortunately, the tocometric methods thus far employed are not wholly reliable. Though we have no means of knowing the exact value of a labor pain, it probably never exceeds and seldom attains the maximum limit above stated.

CHANGES IN THE SHAPE AND POSITION OF THE UTERUS. During a contraction the uterus assumes approximately a cylindrical form, its longitudinal and antero-posterior diameters being increased, while its transverse is diminished. In other words, its cross-section takes on a more nearly circular shape. The fundus is held forward against the abdominal wall, and the entire organ is forced downward. The long axis of the uterus is brought in line with that of the pelvic inlet. The capacity of the upper or contractile segment is diminished, that of the lower or passive segment is correspondingly increased. The peritoneal covering adapts itself to the changing shape and size of the uterus by reason of its elasticity. The muscular structures of all the uterine ligaments doubtless contract simultaneously with those of the organ itself, and to some extent they assist in the expulsion of its contents as well as in fixing the uterus.

(*b*) **The Action of the Abdominal Muscles.** The uterine contractions alone are concerned in the dilatation of the lower segment of the uterus which takes place in preparation for the expulsion of the fœtus. Dilatation complete, the action of the uterus is reinforced by that of the abdominal walls. At the height of the uterine contraction the woman holds her breath, the diaphragm is fixed, and the intra-abdominal pressure is increased by the contractile power of the abdominal muscles. This adds materially to the expelling force, compressing the active portion of the uterus on all sides. The extruding force of the uterine contraction is supplemented by the general intra-abdominal pressure, and the contents of the organ are impelled in the direction of least resistance, downward through the expanded cervix.

Yet the action of the abdominal muscles is not in all cases an essential factor in labor. It is well known that the uterus may expel its contents unaided by the accessory powers. This is exemplified in paraplegic women and in spontaneous deliveries under anæsthesia.

Ordinarily the contractions of the abdominal muscles are under control of the will. Toward the close of the second stage, owing to the reflex effect of painful distention of the passages, they become more or less involuntary in character.

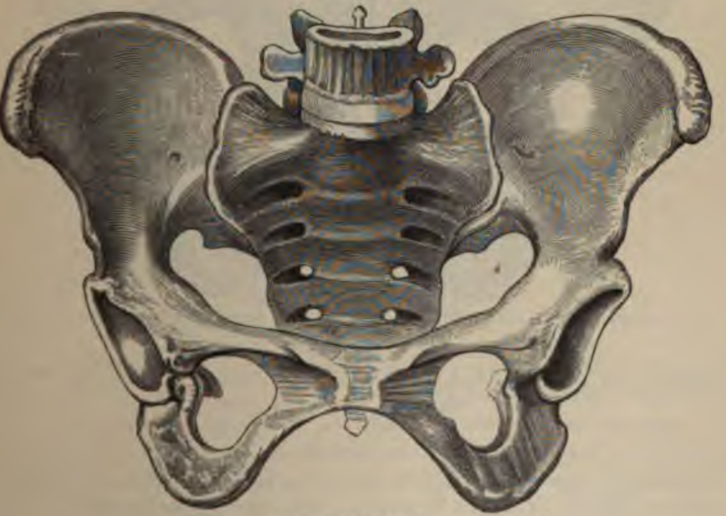
(*c*) **The Action of the Pelvic Floor.** The resistance of the pelvic floor acts in some degree as an obstacle to the progress of the birth until the head is on the eve of expulsion. From this time the muscular tonicity of the posterior portion of the floor helps to impel the head forward in the direction of the outlet of the soft parts. The same force, too, aids in the expulsion from the vagina of the after-coming pole of the fœtus and in the extrusion of the placenta.

II. The Passages.

Obstetric Anatomy of the Bony Pelvis.

The pelvis is the strong bony basin which forms the most important part of the birth-canal. (Fig. 143.) The term is derived from the Greek word πελις, a bowl. The pelvic canal is irregularly funnel-shaped and somewhat flattened from before backward, its larger end looking upward and forward, its smaller downward and backward, in the erect position of the woman. In it are contained the essential organs of generation, and through it the child is expelled in the course of labor. Upon its relation to the size and shape of the fœtal mass depend the more important mechanical phenomena of childbirth. An intimate knowledge

FIG. 143.



The female pelvis.

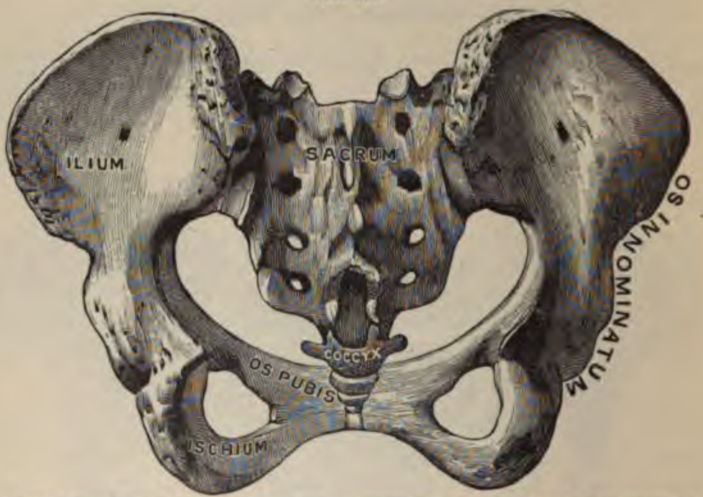
of the pelvis, as related to the mechanism of labor, affords the "key to the obstetric art."

The Constituent Parts of the Pelvis are: the sacrum, the coccyx, and the two ossa innominata. Each of these bones, though made up of separate segments in infancy, is, with the exception of the coccyx, practically one in the child-bearing woman.

The Pelvic Joints. Of obstetric importance are the pelvic articulations. They are the sacro-iliac joints, the sacro-coccygeal joint, and the symphysis pubis.

THE SACRO-ILIAC JOINTS. In these joints each articular surface is invested with a thin plate of cartilage. Small interspaces containing a fluid resembling synovia are usually observed between the cartilages, especially in women; rarely these spaces are wholly absent, and even when they exist a synovial membrane cannot always be demonstrated. In a considerable proportion of cases a true synovial cavity is present and the joint is arthrodial in variety. (Browning.)

FIG. 144.



Female pelvis, posterior view, showing constituent parts. (Modified from TESTUT.)

The ligaments are the anterior sacro-iliac, the posterior sacro-iliac, and the interosseous ligament.

The *anterior sacro-iliac ligament* is made up of numerous thin and comparatively weak ligamentous bands.

The *posterior sacro-iliac ligament* is of great strength and importance. It consists chiefly of three fasciculi: the two superior run in a nearly horizontal direction from bone to bone; the inferior extends obliquely downward and inward from the posterior superior spine of the ilium to the third and fourth pieces of the sacrum. The latter is the *oblique sacro-iliac ligament.*

The *interosseous ligament* consists of separate bands of fibrous tissue extending between the articular surfaces. This is not always present.

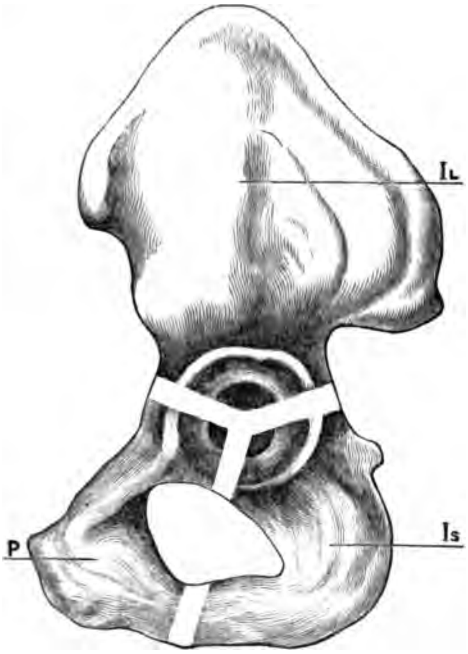
THE SACRO-COCCYGEAL JOINT. This joint has an interosseous fibro-cartilage which permits recession of the coccyx. Its ligaments are four, one at each aspect of the joint. The articulations of the coccygeal segments usually retain some degree of mobility upon one another during the child-bearing period.

THE SYMPHYSIS PUBIS. The articular surfaces of the pubic bones are united by a disk of fibrous tissue and fibro-cartilage. This interpubic disk is slightly wedge-shaped, being thicker at its anterior than its posterior margin, and thicker at the upper than the lower end of the joint. A small cavity is frequently present in the interosseous disk; it is produced by absorption of the fibro-cartilage, and is never synovial in character. (Browning.) It is oftenest observed in the female.

There are four pubic ligaments, one on each aspect of the joint.

The *anterior pubic ligament* consists of two sets of superficial fibres, each running obliquely downward across the joint from one pubic bone to the other, and of a deep layer which stretches directly across the symphysis. The fibres of the latter are blended with the subjacent fibro-cartilage.

FIG. 145.



Os innominatum before fusion of its three constituent parts. (RIBEMONT-DESSAIGNES and LEPAGE.)
Il. Ilium. Is. Ischium. P. Pubis.

The *posterior pubic ligament* is essentially a layer of thickened periosteum which passes from the posterior surface of one pubic bone to that of its companion.

The *superior pubic ligament* is a thin bundle of fibres which connects the upper aspect of the bones.

The *inferior pubic ligament*, the ligamentum arcuatum, is a stout, strong, fibrous bundle arching across from the inferior margin of one descending pubic ramus to the other. It blends at the median line with the interpubic disk.

Mobility of the Pelvic Joints. A barely perceptible mobility of the pubic bones upon each other is generally present in the last weeks of gestation. Experience in symphyseotomy has shown that the sacro-iliac articulations are sufficiently movable to permit a separation of the pubic bones to the extent of 5 to 7.5 cm., 2 to 3 inches, after section of the symphysis, without injury to the anterior ligaments The sacrum, too, is capable of rotation in some degree on a transverse axis drawn through its base a little below the level of the promontory. Not only is there a hinge-like motion at the sacro-coccygeal joint, but the segments of the coccyx, as already stated, have some degree of mobility upon one another. Owing to the swelling of the interarticular structures which obtains in all the pelvic articulations toward the close of pregnancy some expansion of the pelvic planes is possible during labor under the wedge-like action of the fœtal head.

The False and the True Pelvis. The bony pelvis presents two divisions —the *false* and the *true* pelvis, or the *greater* and the *lesser* pelvis. The dividing plane cuts the upper anterior margin of the sacrum, the upper end of the symphysis pubis, and the ilio-pectineal line on either side. The part above this plane is the false, that below the true, pelvis.

The false pelvis, together with the vertebral column and the abdominal walls, forms a funnel-shaped approach to the true pelvis. The space included is a part of the abdominal cavity.

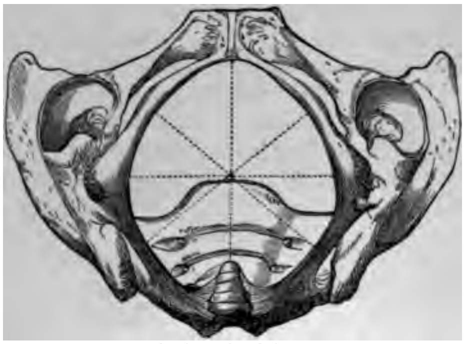
The true pelvis. It is with the true pelvis that obstetric problems have mainly to deal. Here it is that the principal resistance to the birth is encountered, and here the more important mechanical phenomena of labor are executed. Upon a clear comprehension of the anatomy of this part of the pelvis in its relation to the parturient process the skill of the obstetrician will largely depend.

The Brim, Inlet, Superior Strait, Isthmus, or Margin of the True Pelvis. The anatomical inlet is located by the upper margin of the sacrum, the ilio-pectineal lines, and the upper end of the symphysis. Its outline is generally described as approximately heart-shaped. Its contour corresponds nearly to that formed by two ellipses overlapping anteriorly, each of these ellipses representing the engaging sectional plane of the fœtal head. In exceptional cases the brim is an irregular oval or is nearly round in shape.

Obstetric Landmarks at the Brim. Certain anatomical points about the pelvic inlet are frequently referred to as landmarks, both in obstetric writings and in practice. They are: 1. The sacro-vertebral angle, or the promontory of the sacrum. The angle is formed by the inclination of the pelvis, the intervertebral cartilage between the last lumbar and the first sacral vertebræ being wedge-shaped, with its base to the front. (Fig. 148.) 2. The sacro-iliac joints, or rather the points at which they are met by the ilio-pectineal lines. 3. The ilio-pectineal eminences situated on the pubic bones close to the ilio-pubic junctions. 4. The symphysis pubis.

The Outlet or Inferior Strait of the Pelvis. The anatomical outlet of the pelvis is bounded by the summit of the subpubic arch, the ischial tuberosities, and the tip of the coccyx. The outline is that of a lozenge-shaped figure whose angles have been rounded. (Fig. 146.) Owing to the distensibility of the sciatic ligaments, to the yielding character of the coccyx, and, to some extent, of the sacro-iliac joints, the contour of the outlet becomes ovate at the expulsion of the head. (Fig. 147.)

FIG. 146.

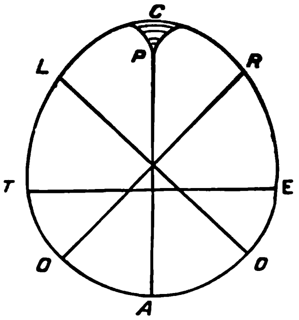


Outlet of pelvis.

It will presently be seen that the superior and the inferior strait in the obstetric sense are not identical with the anatomical brim and outlet respectively.

Obstetric Landmarks at the Outlet. Anatomical points about the outlet which are of special importance as obstetric landmarks are the following: 1. The tip of the coccyx, and of the sacrum. 2. The subpubic arch. 3. The ischial tuberosities. 4. The ischial spines. 5. The obturator foramina.

FIG. 147.



The outlet as seen from below. *C.* Under surface of the coccyx. *A P.* The antero-posterior, or pubo-coccygeal diameter. *T E.* Transverse diameter. *R O* and *L O.* Right and left oblique diameters.

Sacro-sciatic Ligaments. The greater and the lesser sacro-sciatic ligaments contribute to the formation of the more resistant portion of the parturient canal, which is mainly formed by the bones.

The greater sacro-sciatic ligament arises from the posterior inferior spine of the ilium and from the side of the sacrum and coccyx, narrows and thickens in the middle of its length, broadens again at its anterior attachment, and is inserted into the inner surface of the ischial tuberosity, sending forward a falciform process upon the ischial ramus. (Fig. 148.)

The lesser sacro-sciatic ligament takes its origin from the side of the sacrum and of the coccyx, and passing in front of the greater is inserted into the spine of the ischium. (Fig. 148.)

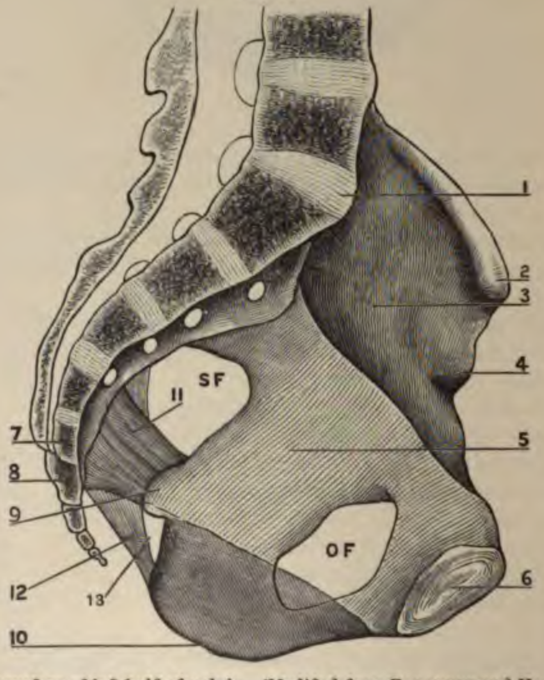
The open spaces between the greater and the lesser sciatic notches and the ligaments are respectively the greater and the lesser sciatic foramina.

The Cavity of the True Pelvis is bounded posteriorly in the main by the sacrum and the coccyx, anteriorly by the pubic bones and their rami, laterally by the lower portions of the ilia and the bodies, tuberosities,

spines, and rami of the ischial bones. It is irregularly cylindric
shape. The posterior wall is smooth, and is concave from above d
ward; its depth, measured on the curve of the sacrum and coccy
11.5 to 12.5 cm., $4\frac{1}{2}$ to 5 inches.

The anterior wall is smooth and concave from side to side; a
symphysis its depth is 4 cm., or a little more, $1\frac{5}{8}$ inch. The la
walls corresponding to the broad smooth surfaces of the ischial b
are 9 cm. in depth, $3\frac{1}{2}$ inches. It will be noted that in the passa
the head through the pelvis its posterior pole traverses a much gr
distance than does the anterior before it escapes from the bony c
As will be seen later, the difference in the extent of the posterior an
anterior walls in the soft parts which make up the lower portion o
birth-canal is even greater than in the osseous portion of the partu
tract.

FIG. 148.



Interior surface of left half of pelvis. (Modified from FARABEUF and VARNIER.)

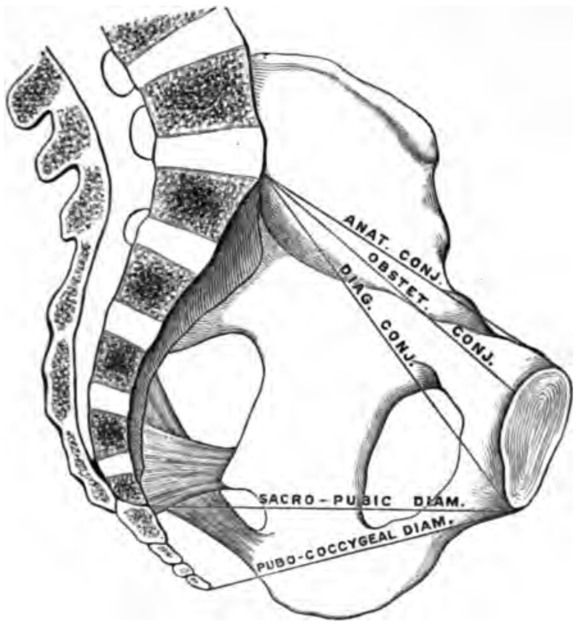
1. Promontory of sacrum. 2. Anterior superior iliac spine. 3. Iliac fossa. 4. Anterior
iliac spine. 5. Lateral surface of pelvic cavity. 6. Symphysis pubis. 7. Tip of sacrum.
piece of coccyx. 9. Spine of ischium. 10. Ischium. 11. Lesser sacro-sciatic ligament. 12.
sacro-sciatic ligament. 13. Lesser sacro-sciatic foramen SF. Greater sacro-sciatic foramen
Obturator foramen.

Obstetric Planes of the Pelvis. The short curved canal, bounde
the bony walls just described, varies somewhat in shape and in si
different parts of its course. These variations are best understood
the aid of a series of planes drawn transversely through the pelvic c
at different levels. Three are of special obstetric importance.
are the plane of the brim, the plane of the outlet, and the middle p

By the dimensions of these planes the presence or absence of deformity in the canal may usually be determined.

PLANE OF THE PELVIC BRIM. The obstetric inlet is the space available for the passage of the head at the superior strait. It is not strictly coincident with the anatomical brim. The latter is the entrance of the lesser pelvis, the former the level of least expansion at the upper portion of the pelvic canal. The plane of the obstetric inlet is located by the summit of the sacral promontory, the ilio-pectineal line, and the posterior surface of the symphysis at a point about 1 cm., $\frac{3}{8}$ of an inch, below its upper margin. (Fig. 149.)

FIG. 149.



The diameters of the pelvis. Shows also location of anatomical and obstetric inlet and outlet. (FARABEUF.)

PLANE OF THE PELVIC OUTLET. The structures which bound the anatomical outlet of the pelvis posteriorly are not wholly fixed, but they yield somewhat during labor under pressure of the advancing head. The plane of greatest bony resistance at the inferior strait, therefore, is not that of the anatomical outlet, but a plane somewhat above it. The latter is the inferior strait from the obstetric stand-point. For the obstetrician the plane of the pelvic outlet is one defined by the tip of the sacrum, the ischial tuberosities, and the posterior surface of the pubic symphysis at a point immediately above its lower margin. At the expulsion of the head from the bony outlet, owing to the yielding character of the sciatic ligaments, the shape of this plane becomes ovate, with its greatest expansion directed posteriorly.

THE MIDDLE PLANE. This plane cuts the upper end of the third piece of the sacrum, the middle of the symphysis pubis, and points opposite the centres of the acetabular cavities. The latter p somewhat larger, the plane of the inferior strait a little small that of the pelvic brim.

Inclination of the Pelvis. The plane of the pelvic brim forms a with the horizon of from 50 to 60 degrees, according to the pos the body. The upper margin of the symphysis pubis in the ere

FIG. 150.

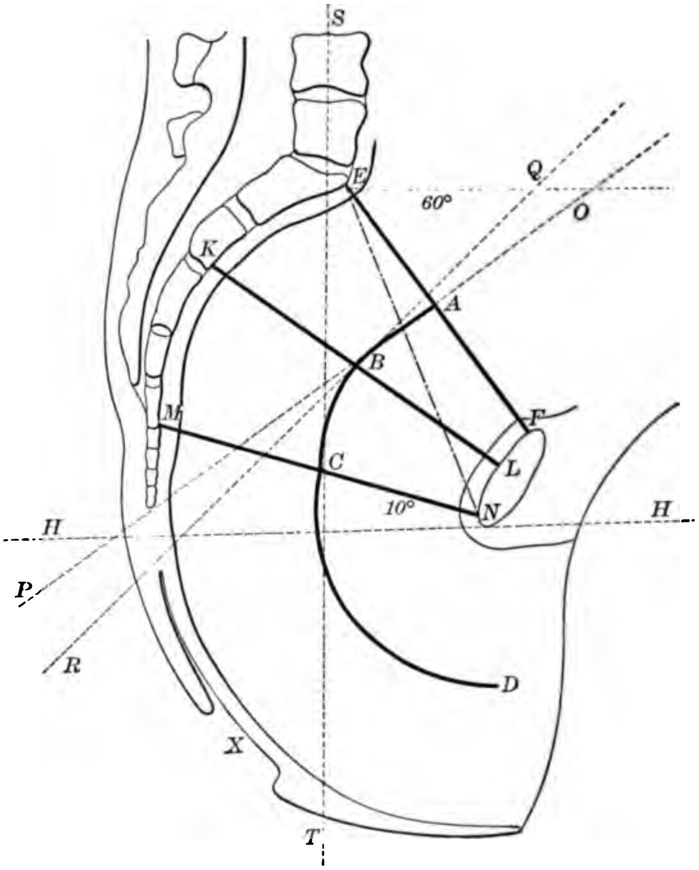


Diagram showing axis and planes of pelvis.

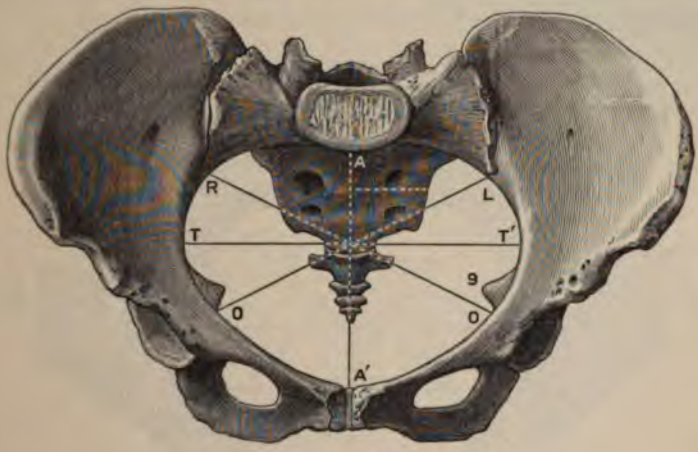
A B C D. Axis of entire parturient canal. *X.* Anus as distended at acme of expulsion. of brim. *K L.* Mid-plane of cavity. *M N.* Plane of outlet. *O P.* Axis of brim. *Q R.* Ax plane. *S T.* Axis of outlet. *H H.* Horizon. *E N.* Diagonal conjugate diameter.

tion of the woman is nearly 9 cm., 3½ inches, below the level promontory. The coccyx is 2 cm. above the level of the subpubi the pubo-coccygeal line making an angle of 10 degrees with the h The direction of the pelvic canal at the inlet turns sharply ba from the body axis. Yet it must be remembered that the inclin the pelvis is subject to considerable variation in different postures body.

The Pelvic Diameters and Measurements.

The varying size and shape of the bony canal at different levels are indicated by the varying dimensions of the horizontal planes of the pelvis. These dimensions are measured on each plane in four directions: the antero-posterior, the transverse, and the two oblique. The several diameters of these planes taken together are spoken of as the internal diameters of the pelvis.

FIG. 151.



Obstetric diameters of the pelvic brim.
A A′. Conjugate diameter. T T′. Transverse diameter. L O. Left oblique diameter.
R O. Right oblique diameter.

INTERNAL DIAMETERS OF THE STATIC OR DRIED PELVIS.

At the Brim. THE ANTERO-POSTERIOR DIAMETER at the brim is the least distance between the sacral promontory and the pubic symphysis. It represents the available interval between the two surfaces for the passage of the head. It extends from the middle of the sacral promontory to the posterior surface of the symphysis at a point about two-fifths of an inch below its upper margin. It is termed the *conjugate*, or the *true conjugate*, and its value is 11 cm., $4\frac{3}{8}$ inches. (Fig. 151.)

THE TRANSVERSE DIAMETER is the greatest distance between the ilio-pectineal lines, and measures 13.5 cm., $5\frac{1}{4}$ inches. The greatest transverse diameter of the pelvic brim, however, lies too near the promontory to be available for the passage of any of the conventional diameters of the fœtal head. In a typical relation of head to pelvis, therefore, the head never passes in transverse position. (Fig. 151.)

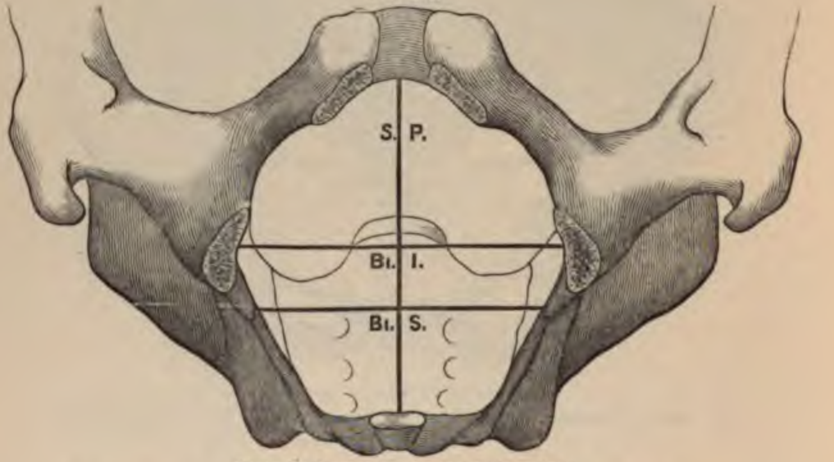
THE OBLIQUE DIAMETERS extend, one from the right, the other from the left sacro-iliac joint at its intersection with the ilio-pectineal line, to the opposite ilio-pectineal eminence. The right oblique springs from the right, the left oblique from the left sacro-iliac articulation. Their values are each about 12.5 cm., 5 inches. (Fig. 152.) The right oblique diameter is slightly longer than the left. It should be noted that by French writers this nomenclature of the oblique diameters is reversed, the left oblique being that which ends at the left and the right oblique that which ends at the right anterior aspect of the pelvic brim.

At the Middle Plane. THE ANTERO-POSTERIOR DIAMETER is the distance from the upper margin of the third piece of the sacrum to the posterior surface of the symphysis pubis at the middle point of its depth, and is 12.5 cm., 5 inches.

THE TRANSVERSE DIAMETER is the greatest transverse width of the pelvis at this plane, and measures 12 cm., 4¾ inches.

THE OBLIQUE DIAMETERS are not measured from fixed points, and are, therefore, valueless for obstetric purposes.

FIG. 152.



Obstetric diameters of the pelvic outlet.

S. P. Sacro-pubic diameter. Bi. I. Bisischial diameter. Bi. S. Bisciatic diameter.

At the Outlet. THE ANTERO-POSTERIOR DIAMETER of the obstetric outlet is a line drawn from the tip of the sacrum to a point just above the summit of the subpubic arch. Its value is 11.5 cm., 4½ inches.

THE GREATEST TRANSVERSE DIAMETER is the bisischial line, and is 11 cm., 4⅜ inches. It is measured from the inner surface of the ischial tuberosities at the middle of their posterior borders, and corresponds in the living pelvis to a line running transversely through the anterior margin of the anal orifice. The antero-posterior diameter of the anatomical outlet extends from the tip of the coccyx to the summit of the subpubic arch, and measures 9 cm., 3½ inches. The distance between the ischial spines, the bisischiatic diameter, is 10.5 cm., 4⅛ inches.

The oblique diameters at the outlet are of little practical importance, since their posterior extremities do not rest on fixed points. (Fig. 152.)

SHAPE OF THE PELVIC CANAL. It will be seen by comparing the dimensions of the different planes that the pelvic canal grows progressively narrower in its transverse diameter from the brim to the outlet, the difference at these two levels amounting to 2.5 cm. In the sagittal direction the canal is narrowest at the brim and most roomy at the middle plane. The antero-posterior diameter at the middle plane is

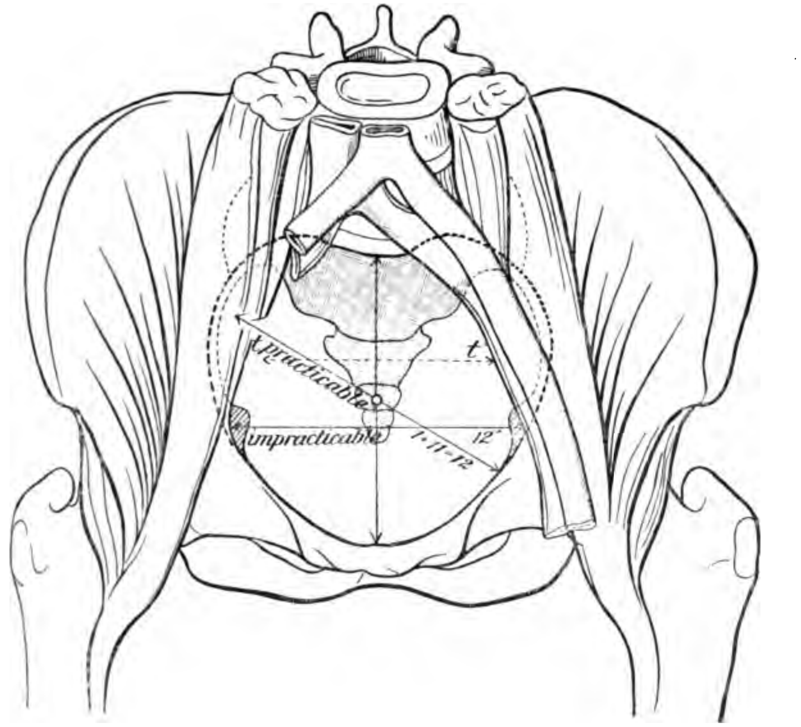
1.5 cm. longer, at the inferior strait it is 5 cm. longer than at the inlet.

Measurements of the Dynamic Pelvis.

Internal Measurements. The dimensions thus far stated relate to the anatomical or dried pelvis. In the pelvis of the living woman—the *dynamic pelvis*—the measurements are more or less modified by the presence of the soft structures which line the bony canal. The internal diameters are all diminished from an eighth to a quarter of an inch by the thickness of the soft parts.

At the brim, owing to the encroachment of the ilio-psoas muscles upon the pelvic space, the transverse diameter is reduced still more, so that, while in the anatomical pelvis the transverse is the longest dimension at the inlet, the oblique is greatest in the obstetric patient. (Fig. 153.)

FIG. 153.



Diameters of the pelvic inlet as affected by the principal soft parts. The oblique is the longest practicable diameter in the dynamic pelvis. (FARABEUF.)

External Measurements. The external bear a fairly constant relation to the internal dimensions of the pelvis. External measurements are, therefore, useful to the obstetrician in determining the probable capacity of the pelvic canal. They are especially valuable for the reason that they may be more readily and more accurately determined in the living subject than can the internal diameters. The more important external measurements are: The External Conjugate Diameter, or Diameter of Baudelocque, the Interspinal, and the Intercristal Diameters.

THE EXTERNAL CONJUGATE DIAMETER is the distance from the fossa immediately below the spine of the last lumbar vertebra to the most prominent point on the anterior surface of the pubes, two-fifths of an inch below the upper margin of the symphysis, and its value is 20.3 cm., 8 inches.

The external conjugate is obviously subject to considerable variation, dependent on the thickness of the bony structures and of the overlying soft parts. The difference between the external and the internal conjugate ranges from 7 to 12.7 cm., 2¾ to 5 inches, the average being 9 cm., 3½ inches.

THE INTERSPINAL DIAMETER is the distance between the outer aspects of the anterior spines of the ilium, measured from the outer margins of the insertion of the sartorii, 25.5 cm., 10 inches.

THE INTERCRISTAL DIAMETER is the greatest distance between the outer borders of the iliac crests, 28 cm., 11 inches.

EXTERNAL OBLIQUE DIAMETERS. In addition to the foregoing may be mentioned the *external oblique diameters;* they are respectively the distance from the posterior superior spine of one to the anterior superior spine of the opposite iliac bone, 22 cm., 8¾ inches.

THE BISISCHIAL DIAMETER, 11 cm., 4⅜ inches, since it may be measured externally as well as internally, may be enumerated with the external diameters.

THE BITROCHANTERIC DIAMETER, which is the distance from one trochanter major to its companion, is usually included with the pelvic measurements. Its value is 31 cm., 12¼ inches.

The following tabular statement of the pelvic measurements will be found convenient for reference:

SUMMARY OF INTERNAL MEASUREMENTS OF THE DRIED PELVIS.

	Antero-posterior diameters.	*Oblique diameters.*	*Transverse diameters.*
Brim .	. 11 cm, 4⅜ inches.	12.5 cm., 5 inches.	13.5 cm., 5¼ inches.
Mid-plane	. 12.5 cm., 5 inches.	12 cm., 4¾ inches.	12 cm., 4¾ inches.
Outlet .	. 11 5 cm., 4½ inches.	....	11 cm., 4⅜ inches.

Circumference of the brim, 40 cm., 16 inches; of the outlet, 33 cm., 13 inches.

The internal diameters of the dried pelvis, as stated in the following table, are sufficiently exact for practical purposes, and they have the advantage of being easily remembered:

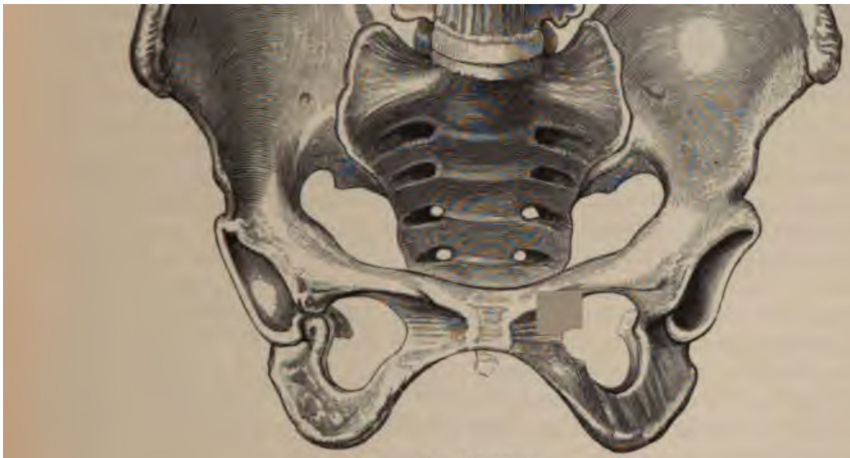
APPROXIMATE INTERNAL MEASUREMENTS OF THE PELVIS.

	Antero-posterior.	*Oblique.*	*Transverse.*
Brim	4 inches.	4½ inches.	5 inches.
Mid-plane	4½ "	4½ "	4½ "
Outlet	5 "	4½ "	4 "

SUMMARY OF EXTERNAL MEASUREMENTS OF THE DYNAMIC PELVIS.

External conjugate diameter	20.3 cm.,	8 inches.
Interspinal	25.5 "	10 "
Intercristal	28 "	11 "
Bitrochanteric	31 "	12.4 "
External oblique	22 "	8¾ "
Bisischial	11 "	4⅜ "

The *average external circumference* of the pelvis measured over the symphysis, just below the iliac crests, and across the middle of the sacrum is one yard.



Female pelvis.

FIG. 155.

somewhat smaller and the true pelvis larger in all diameters and of shallower depth.

The brim is less triangular and its capacity greater, the sacro-vertebral angle is more prominent. The ilio-pectineal lines are more strongly curved, and the pubic spines are farther apart.

The cavity is less funnel-shaped, and all its horizontal diameters are greater. The sacrum is shorter and broader, and it presents a more nearly uniform antero-posterior curvature.

The outlet is larger; the width of the subpubic arch is greater, 80 to 100 degrees or more, the angle in the male measuring from 70 to 80 degrees. The depth of the symphysis pubis is less.

Differences Dependent on Racial Characteristics.

Marked differences in the form and size of the pelvis obtain in different races. Yet these variations of type are largely due, as Spiegelberg has intimated, to conditions of nutrition and activity.

Pelvic deformities are most frequent in the inferior races. A larger proportion of dwarfed pelves is observed in races of a low order of physical development. A common deviation from the normal Caucasian type consists in a relative elongation of the antero-posterior dimensions of the pelvis as compared with the transverse. Thus the pelvis of the Australian is nearly circular in horizontal outline, and in Bush women the antero-posterior exceed the transverse diameters. The pelvis of the Laplander is small.

Obstetric Anatomy of the Soft Parts of the Parturient Tract.

The Uterus forms a part of the parturient canal. Yet, as will be seen in connection with the physiology of labor, the organ resolves itself into two segments which sustain very different relations to the parturient process, an upper, contractile, and a lower, passive, segment. The upper segment is of interest chiefly as the principal source of the propelling power, the lower, the seat of resistance at the beginning of labor, belongs more properly to the passages than does the contractile portion of the organ.

The Soft Parts of the Pelvis which concern the obstetrician are chiefly the muscles which line the bony excavation and the structures which compose the pelvic floor. The former, as already stated, reduce slightly the capacity of the bony cavity; the latter supplement the osseous portion of the parturient tract. Lying immediately above the lateral margins of the brim, the iliacus and psoas muscles diminish the transverse width of the bony inlet to the extent of about a quarter of an inch on each side. The external iliac vessels run along the inner borders of these muscles. The main trunk of the lumbar plexus follows the course of the psoas, and the crural nerve runs between the psoas and the iliacus muscles.

The median portion of both the anterior and the posterior pelvic walls is devoid of muscular coverings. On either side of the median section lie the pyriformis posteriorly and the obturator internus anteriorly and laterally. These muscles are thin and are so located as scarcely to lessen appreciably the capacity of the pelvis.

The Pyriformis is a fan-shaped muscle arising by digitations from the anterior aspects of the second, third, and fourth sacral vertebræ, from the upper margin of the greater sciatic notch, and from the anterior surface of the greater sacro-sciatic ligament; it passes out of the pelvis by the greater sacro-sciatic foramen to its insertion in the femur. The nerves of the sacral plexus lie in front of this muscle.

The Obturator Internus Muscle arises from the inner surface of the obturator membrane, from the fibrous arch which completes the canal for the obturator vessels and nerves, and from the inner surface of the innominate bone anteriorly between the obturator foramen and the margin of the ischio-pubic ramus, and laterally over an area extending backward to the sciatic notch, upward to the brim, and downward to the outlet; a few fibres arise from the obturator fascia which covers the internal surface of the muscle; its fibres converge and pass out through the lesser sacro-sciatic foramen to be inserted into the great trochanter.

The Bladder in the front portion of the pelvic cavity does not when empty appreciably diminish its capacity. Moreover, during the beginning stage of labor, as will be explained later, the greater portion of this viscus is drawn up above the inlet of the pelvis.

The Rectum at the brim lies in front of the left sacro-iliac joint; it thence runs inward to descend in the median line along the anterior surface of the sacrum and the coccyx. It encroaches but little on the pelvic space except when distended, yet the left oblique diameter at the brim, which in the dried pelvis is shorter than the right, is rendered still more so by the presence of the rectum, especially when the latter is filled. The greater frequency with which the head enters the pelvis in the right oblique diameter than in the left is explained by these facts.

The Pelvic Floor comprises the soft structures which close the outlet of the bony pelvis and give support to the pelvic and abdominal contents. Its upper limit is the peritoneum except where that structure is lifted off to be reflected over the pelvic viscera. Its lower surface is the skin. At its median portion it is obliquely traversed by three muscular slits, the urethra, the vagina, and the rectum, all approximately parallel with the pelvic brim, save that the lower end of the rectum turns backward nearly at a right angle with the vagina.

The posterior vaginal wall and the soft structures behind it constitute the *sacral segment;* the anterior wall of the vagina and the soft parts in front of it compose the pubic segment of the pelvic floor (Hart).

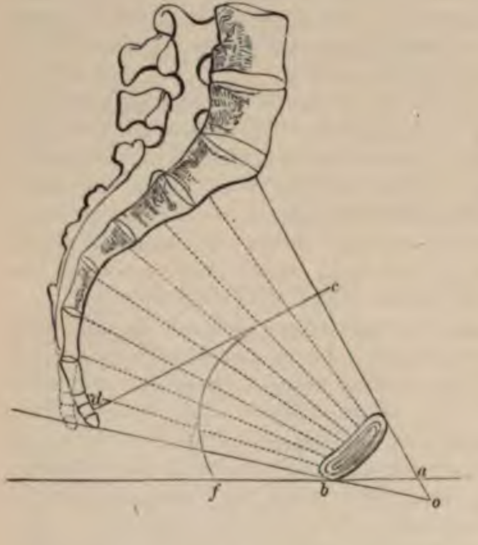
In labor the pubic segment of the floor is drawn upward and the sacral segment is distended and thrust downward as the fœtus descends through the infra-osseous portion of the parturient canal. The resiliency of the posterior segment of the floor holds the fœtal mass in close relation with the ischio pubic rami during the completion of the birth, and assists in its final expulsion.

Measurements. In the nullipara the distance from the coccyx to the anus is 4.5 cm., 1¾ inch; from the anus to the lower margin of the vulvar orifice, 3.2 cm., 1¼ inch; in the parous woman the latter distance is 2.5 cm., 1 inch; in the primigravida at term, 3.8 cm., 1½ inch. The greatest transverse width of the pelvic floor, on the bisischial line, is 11 cm., 4⅜ inches; the perpendicular thickness at the anus is about 5 cm., 2 inches. In the non-gravid woman the average projection below a line drawn from the tip of the coccyx to the summit of the subpubic arch is about 2.5 cm., 1 inch. The length of the sacral segment during labor at the acme of expulsion—coccyx to lower edge of vulvar orifice—is 15 cm., 6 inches.

The more important component parts of the pelvic floor are its muscular structures and fascial sheets. On the latter its strength and supporting power mainly depend.

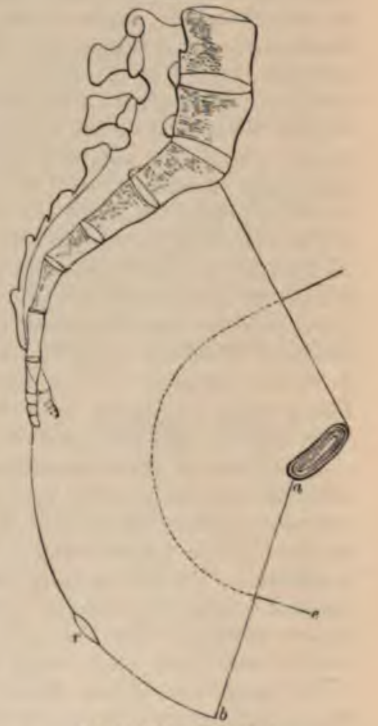
For a detailed description of the anatomy of the pelvic floor the reader is referred to the chapter on The Female Pelvic Organs.

FIG. 156.



Axis of the bony pelvis.
cd. Axis of inlet. *cf.* Axis of bony pelvis.

FIG. 157.



Axis of the birth-canal.
r. Anus. *a b.* Plane of outlet of completed canal. *e.* Perpendicular to plane or axis of expulsion.

The Parturient Axis. It is obvious that an infinite number of pelvic planes may be drawn in addition to the cardinal planes previously described. All, if extended, would meet in front of the pubic joint. The mathematical axis of the pelvic canal is a line which pierces each of these planes perpendicularly at its centre point. Such a line is a curved line with its concavity forward, and it represents very nearly the course which the fœtal head follows in its descent through the pelvis in typical labors. The axis of the inlet prolonged strikes the tip of the coccyx and a point on the abdominal wall near the umbilicus. The axis of the obstetric outlet of the bony pelvis if extended would pass immediately in front of the sacral promontory. The course of the osseous portion of the canal depends upon the longitudinal curvature of the sacrum, and varies accordingly. The plane of the vulvo-vaginal ring at the moment when the fœtal head is expelled is nearly parallel with the long axis of the mother's body. The outlet of the soft parts, therefore, at the acme of expulsion, looks almost directly forward. (Fig. 157.)

III. The Fœtus.

The head, the upper part of the trunk, and the breech of the fœtus each fills the pelvis more or less completely during its passage through it, and each has sufficient rigidity to retain its primal shape in some degree during labor. These parts of the fœtal mass, therefore, all sustain an important relation to the mechanism of labor. The head, however, is much larger in proportion to the trunk in the fœtus than in the adult. As a whole, its diameters are greater than those of the shoulders or the breech and thighs, and are more incompressible. It follows that the principal resistance to the passage of the child through the pelvis is offered by the head. While the body of the fœtus cannot be wholly neglected in the study of the mechanism of labor, it is with the head that obstetric questions are mainly concerned.

Obstetric Anatomy of the Fœtal Head. For the obstetrician the fœtal head present two general divisions: 1, the cranial vault; 2, the cranial base and face. The former, owing to the semi-cartilaginous character and the mobility of its bones, is plastic, a fact of great importance in facilitating the passage of the head through the pelvis; the latter is firm and unyielding, its bony structures being more highly ossified and more firmly united. Protection is thus afforded during birth to the ganglia at the base of the brain.

It is necessary to bear in mind, however, that the plasticity of the fœtal head differs in different infants at term. The degree of ossification and the firmness of union between the cranial bones in the fully developed fœtus are subject to considerable variation, and the hardness of the head is an essential element in the labor.

THE BONES of the cranial vault are the two parietal, the two frontal, the squamous portion of the occipital and those of the two temporal bones. They are united only by the unossified external periosteum and by the dura mater. Both the flexible character of the bones and the existence of membranous interspaces contribute to the plasticity of the cranial vault.

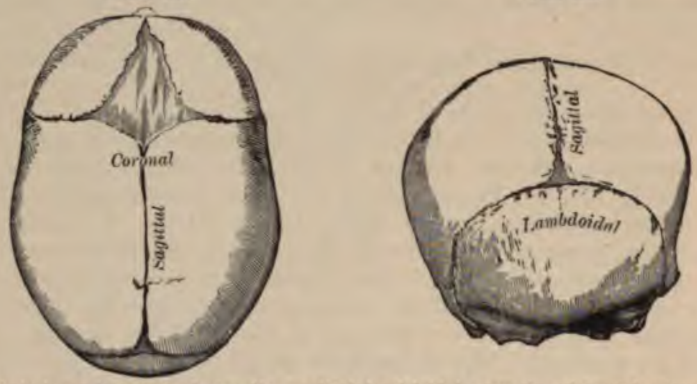
THE SUTURES of the vault are the membranous intervals between two adjacent bones. Those of obstetric importance are the *sagittal* or *inter-parietal*, the *frontal* or *interfrontal*, the *coronal* or *fronto-parietal*, the *lambdoidal* or *occipito*-parietal sutures. (Figs. 158 and 159.)

THE FONTANELLES are the greater spaces formed by the widening out of the sutures between the angles of three or four adjacent bones.

The anterior fontanelle, or bregma, is situated at the junction of the sagittal, the coronal, and the frontal sutures. It is identified in the vaginal examination during labor by the following characters. It is kite-shaped, or quadrangular, with its most acute angle forward. Its average diameter is one inch. Its size, however, varies in different fœtal heads, and is much diminished by overlapping of the bones when the head is firmly wedged in the pelvis. Four lines of sutures run into it.

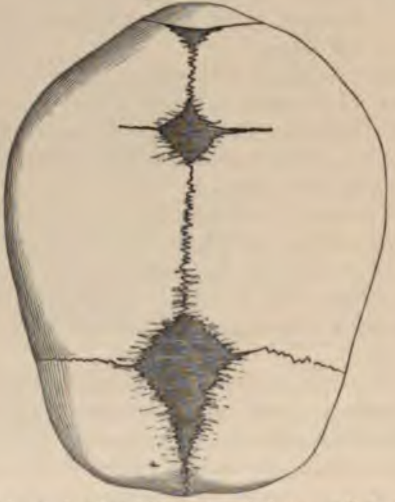
The posterior fontanelle is formed at the junction of the sagittal and the lambdoidal sutures. It presents to the examining finger the following distinguishing marks: It is small, usually a mere depression, barely perceptible to the finger-tip. Three lines of suture run into it. Behind it is the squamous or triangular portion of the occipital bone, which is movable upon the basilar portion by a hinge-like joint of fibrous tissue.

FIG. 158. FIG. 159.



Anterior and posterior fontanelles, sagittal, lambdoidal, coronal, and frontal sutures.

FIG. 160.



Fœtal head seen from above, showing false fontanelle between the anterior and the posterior fontanelle. (After RIBEMONT-DESSAIGNES and LEPAGE.)

In exceptional instances in well-ossified heads this fontanelle is absent. Frequently during labor the interspace is obliterated by the crowding together or overlapping of the cranial bones.

Temporal Fontanelles. A fontanelle exists on either side of the head at the junction of the temporal with the parietal and occipital bones. They are of little obstetric interest, except for the fact that in rare cases one of them may fall within reach of the examining finger and be mistaken for the occipital fontanelle.

False Fontanelles, due to failure of ossification, are exceptionally observed either in the body of the bone or in the course of a suture. (Fig. 160.)

Wormian Bones. Rarely there are small, supernumerary bones in the interparietal space. They are the result of irregular ossification, and are known as Wormian bones.

In the examination of the head for diagnosis of position, the practitioner must have in mind the possibility of being misled by these anomalies.

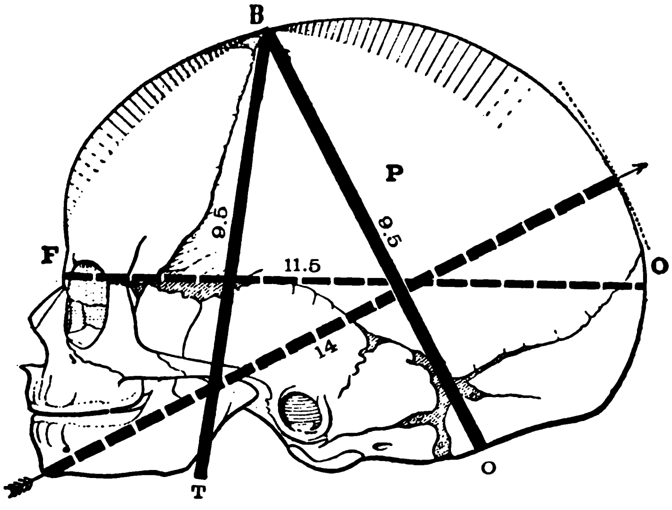
PROTUBERANCES. The cranial bones present five protuberances which are of interest as obstetric landmarks. They are the occipital, the two parietal, and the two frontal. The *occipital protuberance* is situated 2.5 cm., 1 inch, or more behind the posterior fontanelle. The *parietal protuberance* or boss is the bony eminence at the centre of each parietal bone. The *frontal protuberance* is the eminence at the centre of each frontal bone.

THE VERTEX is that portion of the head between the anterior and the posterior fontanelles and extending laterally to the parietal eminences.

THE OCCIPUT is the part of the head behind the posterior fontanelle.

THE SINCIPUT is that portion of the cranial vault in front of the bregma.

FIG. 161.



The diameters of the fœtal head. (Modified from FARABEUF and VARNIER.)

O F. Occipito-frontal. O B. Suboccipito-bregmatic. T B. Trachelo-bregmatic. The maximum diameter, occipito-mental, is indicated by the long dotted arrow. Measurements are in centimetres.

Measurements of the Fœtal Head. Obviously the obstetrician must take into account the shape and dimensions of the fœtal head, as well as of the pelvis. Not only the size, but the configuration of the cephalic mass is an essential element in the relation of the head to the birth-canal. These elements in the obstetric problem are best understood with the aid of a series of head diameters and circumferences measured in different planes. The diameters of the head commonly made use of are the occipito-frontal, the occipito-mental, the suboccipito-bregmatic, the biparietal, the bitemporal, the bimastoid, the fronto-mental, and the trachelo-bregmatic. (Figs. 161 and 162.)

The *occipito-frontal diameter* is measured from the tip of the occipital protuberance to the root of the nose.

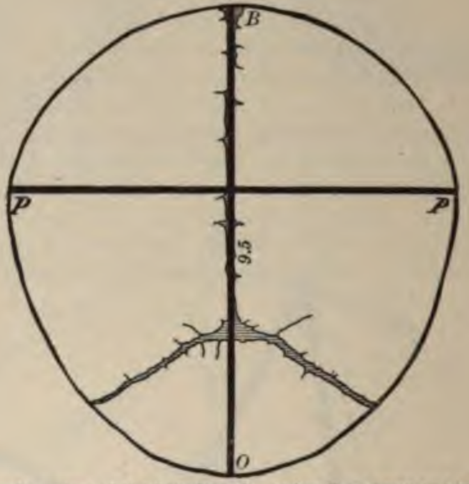
The *occipito-mental* diameter extends from the occipital protuberance to the centre of the lower margin of the chin.

The *suboccipito-bregmatic* diameter extends from the junction of the nucha and the occiput to the centre of the bregma.

The *suboccipito-frontal* extends from the junction of nucha and occiput to the summit of the forehead.

The *biparietal diameter* is measured through the centres of the parietal eminences.

FIG. 162.



Engaging diameters of the flexed head. (After FARABEUF and VARNIER.)
P P. Biparietal diameter, 9 cm. *O B.* Suboccipito-bregmatic diameter, 9.5 cm.

The *bitemporal* is the distance between the lower extremities of the coronal suture.

The *bimastoid* is the distance between the mastoid apophyses.

The *fronto-mental diameter* extends from the summit of the forehead to the centre of the lower margin of the chin.

The *cervico-bregmatic* extends from the junction of neck and chin to the centre of the bregma.

The average values of these diameters are given in the following table:

AVERAGE DIAMETERS OF THE FŒTAL HEAD.

Occipito-frontal diameter	11.5 cm.	4½ inches.
Occipito-mental "	14 "	5½ "
Suboccipito bregmatic diameter	9.5 "	3¾ "
Suboccipito-frontal "	11 "	4⅜ "
Biparietal diameter	9.5 "	3¾ "
Bitemporal "	8 "	3⅛ "
Bimastoid "	7 "	2¾ "
Fronto-mental diameter	9 "	3¼ "
Trachelo-bregmatic diameter	9.5 "	3¾ "

Approximate Diameters of the Fœtal Head. The approximate diameters of the fœtal head may for easy memorizing be stated with sufficient accuracy for practical purposes as follows :

Biparietal	9 cm.	3½ inches.
Suboccipito-bregmatic	9 "	3½ "
Fronto-mental	9 "	8½ "
Occipito-frontal	11.5 "	4½ "
Occipito-mental	14 "	5½ "

Planes of the Fœtal Head. Just as the pelvis is studied with the aid of the horizontal planes, so the size and shape of the head in its relation to the birth-canal may more easily be appreciated with the help of cross-sections made through its more important diameters. Most useful for this purpose are the occipito-mental section through the biparietal and the occipito-mental diameters, the occipito-frontal section through the biparietal and the occipito-frontal diameters, the suboccipito-frontal through the bitemporal and the suboccipito-frontal diameters, the suboccipito-bregmatic through the biparietal and the suboccipito-bregmatic diameters. By comparison of these sectional planes it will be seen that the suboccipito-bregmatic plane, which is the plane that falls in relation with the different pelvic planes successively as the head descends, is not only the smallest but is nearly circular. It measures, after the head is well moulded to the pelvis, 9 cm., about 3½ inches, in the biparietal, and but little more in the opposite diameter. Its circumference is about 33 cm., 13 inches, while the occipito-frontal circumference is 34.5 cm., 13½ inches, and the occipito-mental 35.5 cm., 14 inches. The suboccipito-bregmatic is the plane which engages in complete flexion of the head. Thus it is obvious that the difference between a fully flexed and a partially extended head may make all the difference between an easy and an impossible delivery.

Circumference of the Fœtal Head. The cross-sections of the head whose circumferences are in most cases the maximum circumferences engaging in the pelvis are the suboccipito-bregmatic and the suboccipito-frontal. The occipito-frontal it is well to note, yet the latter is of little practical importance. These cross-sections extend through the corresponding diameters respectively. Their circumferences are as follows :

Suboccipito-bregmatic circumference	33 cm.	13 inches.
Suboccipito-frontal "	35 "	13¾ "
Occipito-frontal "	31.5 "	13½ "

Moulding. Comparing the dimensions of the fœtal head with one another it will be seen that the head during its descent through the pelvis is an irregular cylindrical mass, the long axis of which is 14 cm., 5½ inches, and the transverse 9.5 cm., 3¾ inches.

Normally the long axis of the cylinder lies nearly in relation with the axis of the birth-canal; the engaging diameters of the average head, those which lie across the parturient tract, differ little from those of the maternal pelvis. The value of the suboccipito-bregmatic circumference is the same as that of the pelvic outlet.

In most births the cylindrical form of the cephalic mass becomes still more pronounced during labor, owing to the moulding which takes place from the pressure effects of the birth-canal. The elongation of the cylinder is further increased by the formation upon the presenting part of the caput succedaneum, to be described in another chapter.

The principal diameters of the head are all affected in greater or less degree by the moulding of the head in its passage through the birth-canal. The biparietal is reduced in ordinary labor by about 0.6 cm., ¼ inch. The suboccipito-bregmatic and the suboccipito-frontal are correspondingly shortened. The occipito-mental is lengthened. In a word, the engaging diameters are compressed, and there is a corresponding elongation of the diameter which is in relation with the axis of the parturient tract. The moulding is chiefly the result of overlapping of the cranial bones. It may be noted in passing that the measurements of the head for record should be taken after it has resumed its normal shape.

The head undergoes in slight degree a total reduction in volume during its passage through the pelvis, owing to the fact that a portion of the cerebro-spinal fluid and of the contents of the intracranial blood-vessels is forced out of the cranial cavity by compression.

The plasticity of the head is obviously an essential factor in the parturient process. The hardness of the cranial vault is, therefore, always to be taken into account in estimating the prognosis of labor.

The Trunk. The trunk diameters are small, and moreover are so compressible as to render them of relatively little importance in the mechanism of labor. The longest of the trunk diameters is the bisacromial. Its length is 12 cm., 4¾ inches; but it is reducible to the extent of at least 2 or 3 cm. The antero-posterior or sterno-dorsal diameter at the level of the shoulders is 8.5 cm., 3¾ inches, and is reducible to 8 cm. The average chest measure (circumference) is 12¼ inches. The bitrochanteric diameter is 9 cm., 3½ inches. The antero-posterior diameter at the breech, the sacro-pubic, is 5.5 cm., 2⅛ inches. With the superadded thickness of the thighs flexed upon the abdomen, the antero-posterior diameter is nearly doubled.

Length and Weight of the Mature Fœtus. The length of the child at term is usually between 46 and 51 cm., 18 and 20 inches. The average weight is 3150 to 3290 grammes, 7 to 7¼ pounds, males weighing more than females, and first, as a rule, less than subsequent births. The usual birth-weight may be said to vary from 2700 to 5400 grammes, 6 to 11 or 12 pounds. In very rare instances the latter limit is exceeded, and phenomenal weights of more than 9000 grammes, 20 pounds, have been recorded. There is usually a progressive gain in the weight of the children in successive pregnancies of the same mother till the fourth or fifth.

Mobility of the Fœtal Head Upon the Spinal Column. The movements of extension or flexion and of rotation of the head upon the trunk sustain important relations to the mechanism of labor, as will be seen in connection with the discussion of that subject. These movements are favored by the laxity of the joints in the cervical portion of the spinal column. The limit of safe rotation of the head upon the trunk is generally believed to be 90 degrees on either side. Tarnier, however, points out that the rotation may be continued without injury to the spinal cord or to the ligaments till the face looks directly backward. The torsion is not confined to a single point in the spinal column, but is distributed along the upper portion of its length.

PRESENTATION, POSITION, AND POSTURE OF THE FŒTUS.

Presentation is, in general terms, the relation of the long axis of the fœtal ovoid to the uterine axis. Under this definition we have two varieties of presentation: longitudinal and transverse.

LONGITUDINAL PRESENTATION is that in which the long axis of the fœtal ovoid corresponds with the axis of the uterus, either the cephalic or the pelvic extremity offering at the brim of the pelvis.

TRANSVERSE PRESENTATION is that in which the long axis of the fœtal mass lies across the long axis of the uterus. Except very rarely, however, its direction is not transverse but oblique. In this presentation any part of the fœtus, except the cephalic or the podalic extremity, may offer primarily at the pelvic inlet.

As commonly employed the term presentation refers to the part of the fœtus which presents at the pelvic brim. Thus we have *cephalic* and *breech* as subvarieties of longitudinal presentation; *vertex, face,* and *brow* as subvarieties of cephalic presentation; *breech* and *foot* as subvarieties of pelvic presentation; *shoulder*, *arm,* and *hand* as subvarieties of transverse presentation. Since in transverse presentation the shoulder ultimately becomes the presenting part, transverse is also known as shoulder presentation.

The term *presenting* part is used to denote the part of the fœtal ovoid which offers to the examining finger. It is, therefore, synonymous with presentation in the sense last referred to.

The varieties and subvarieties of presentation may be summarized as follows:

PRESENTATIONS.

1. Longitudinal.
    A. Cephalic. (*a*) Vertex; (*b*) face; (*c*) brow.
    B. Breech. (*a*) Breech; (*b*) knee; (*c*) foot.
2. Transervse.
    (*a*) Shoulder; (*b*) arm; (*c*) hand.

Relative Frequency of the Different Presentations. The vertex presents in about 97 per cent. of all labors at term. Spiegelberg found cephalic presentations in 97 per cent. of the children in 97,871 labors; Lepage in 97.32 per cent. of 3032 primiparæ, and in 97.24 per cent. of 3598 multiparæ, at the Clinique Baudelocque. The breech presents in about 1.6 per cent. of all labors; transverse presentation occurs in 0.5 per cent. The preponderance of vertex presentations is due mainly to adaptation of the fœtal ovoid to the shape of the uterus, and in some degree to gravity, the cephalic being the heavier extremity of the fœtus.

Position. Position is the relation of the presenting part to the quadrants of the pelvic brim, the quadrants being those into which the brim is divided by the antero-posterior and the transverse diameters. For each presentation there are four positions. They are named according to the particular quadrant confronted by the presenting part, sometimes from some anatomical point at the brim selected for its prominence.

In vertex, face, and breech presentations the long diameter of the presenting part engages in one of the oblique diameters of the pelvic inlet. In vertex presentation the occiput looks to the right or to the left anterior or to the right or left posterior quadrant. When the occiput confronts the left anterior quadrant, the position is left occipito-anterior; if it faces the right anterior quadrant, the position is right occipito-anterior, and so on. The positions are sometimes spoken of as first, second, third, and fourth, the left occipito-anterior being the first, and the others following in order from left to right around the pelvic brim. Face positions are named in similar manner according to the direction of the chin—left mento-anterior, etc.; breech positions, according to the direction of the sacrum—left sacro-anterior, etc.; shoulder positions, according to the direction of the scapula — left scapulo-anterior, etc.

Vertex Positions.

Left occipito-anterior. L. O. A.
Right occipito-anterior. R. O. A.
Right occipito-posterior. R. O. P.
Left occipito-posterior. L. O. P.

The relative frequency of the different vertex positions may be roughly stated at 75, 20, 4, and 1 per cent. respectively.

Face Positions.

Left mento-anterior. L. M. A.
Right mento-anterior. R. M. A.
Right mento-posterior. R. M. P.
Left mento-posterior. L. M. P.

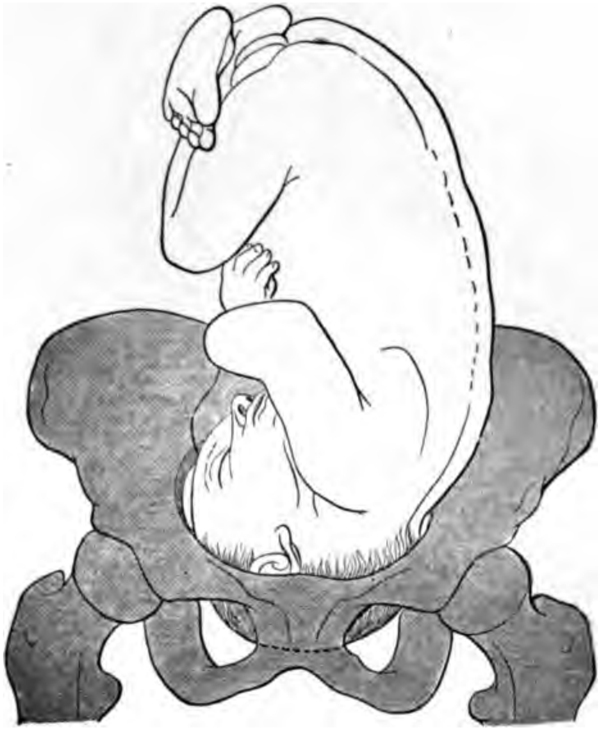
Breech Positions.

Left sacro-anterior. L. S. A.
Right sacro-anterior. R. S. A.
Right sacro-posterior. R. S. P.
Left sacro-posterior. L. S. P.

Transverse or Shoulder Positions.

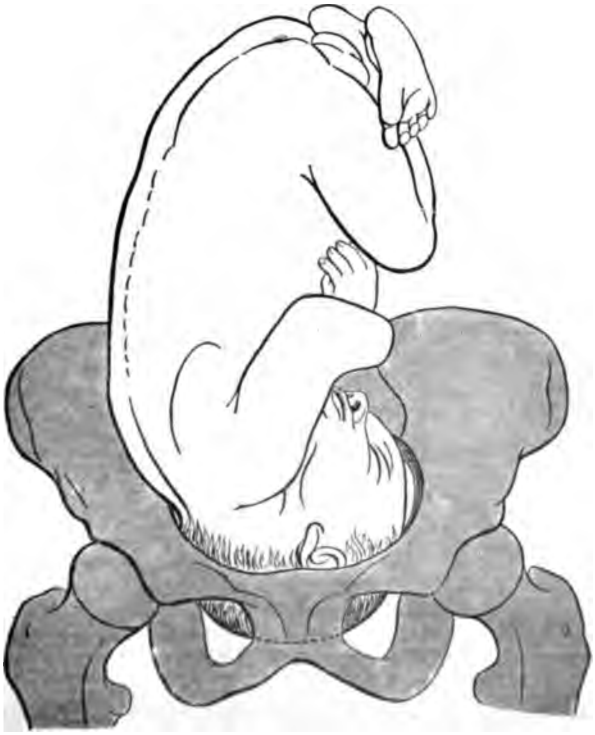
Left scapulo-anterior. L. Sc. A.
Right scapulo-anterior. R. Sc. A.
Right scapulo-posterior. R. Sc. P.
Left scapulo-posterior. L. Sc. P.

FIG. 163.



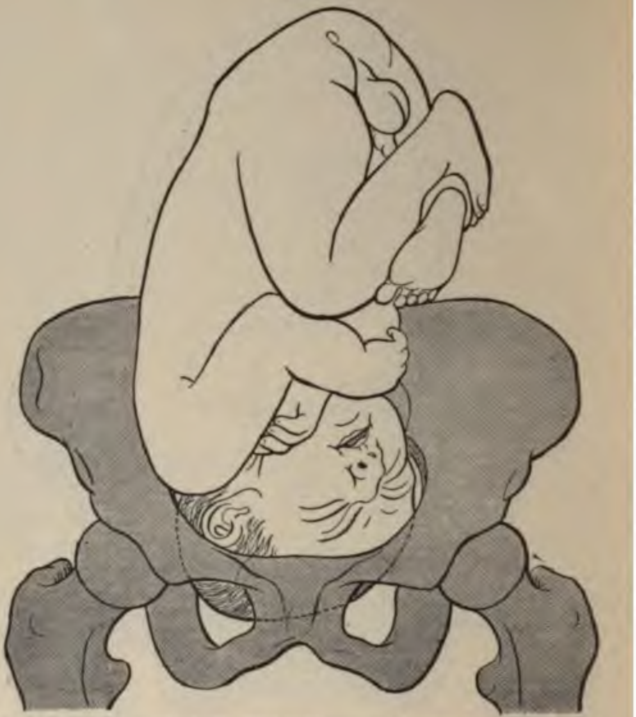
Vertex. Left occipito-anterior position. (FARABEUF and VARNIER.)

FIG. 164.



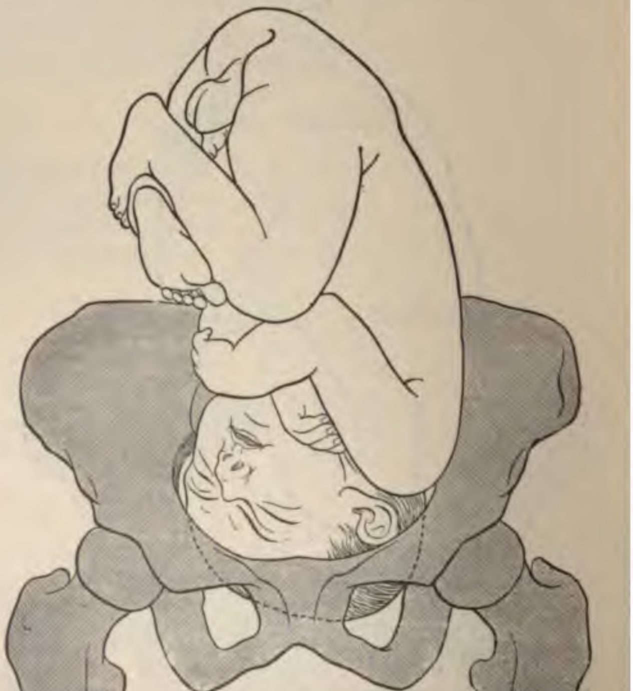
Vertex. Right occipito-anterior position. (FARABEUF and VARNIER.)

FIG. 165.



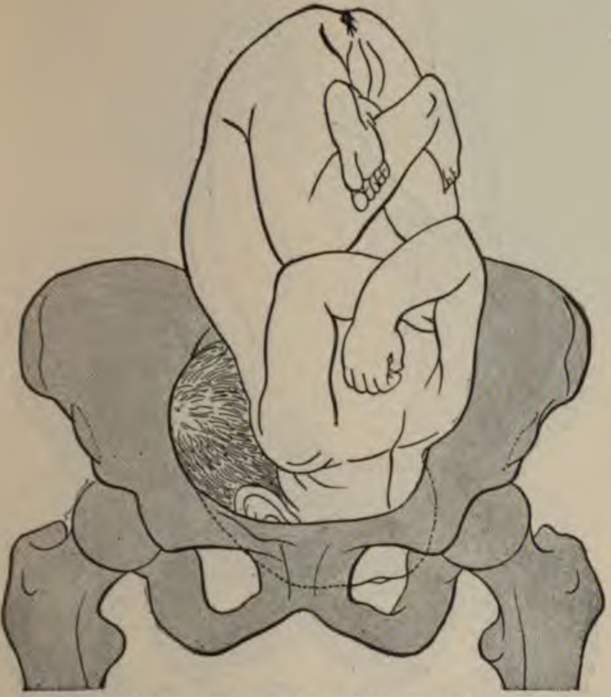
Vertex. Right occipito-posterior position. (FARABEUF and VARNIER.)

FIG. 166.



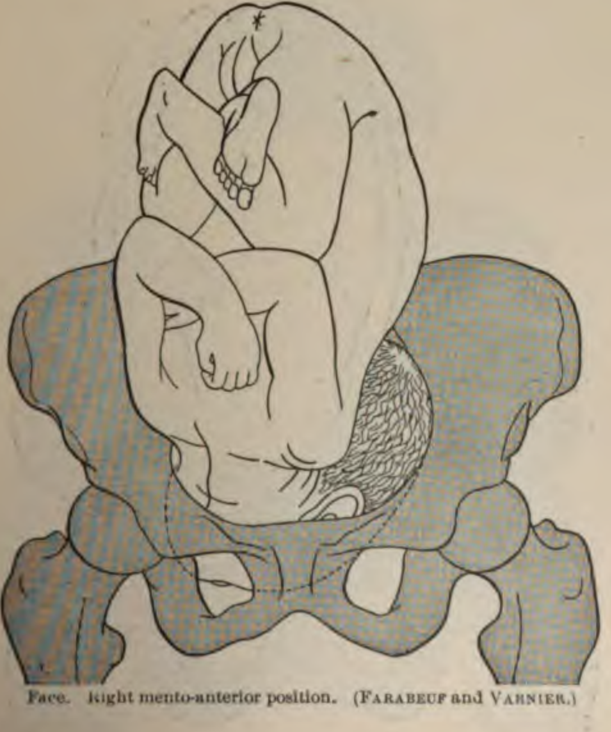
Vertex. Left occipito-posterior position. (FARABEUF and VARNIER.)

FIG. 167.



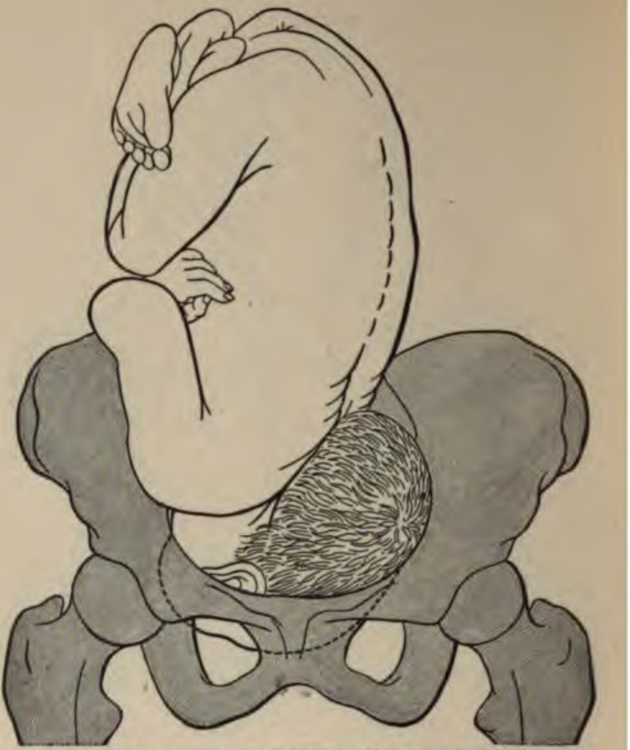
Face. Left mento-anterior position. (FARABEUF and VARNIER.)

FIG. 168.



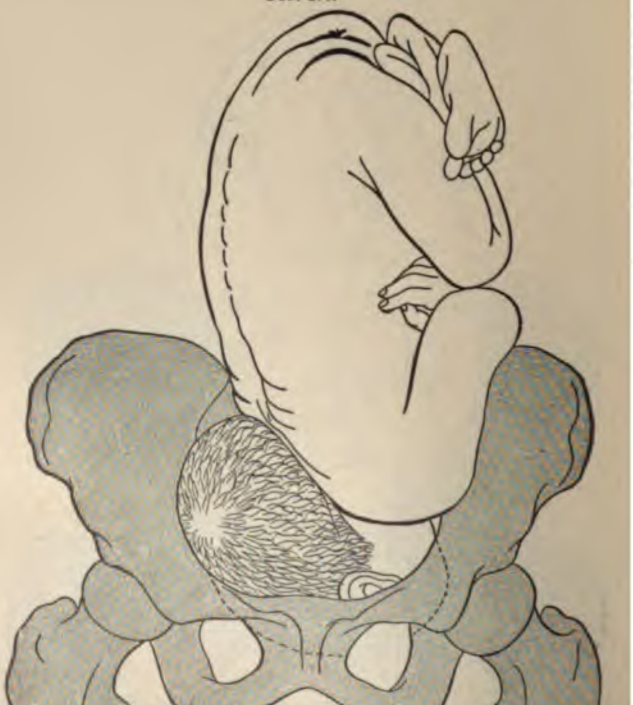
Face. Right mento-anterior position. (FARABEUF and VARNIER.)

FIG. 169.



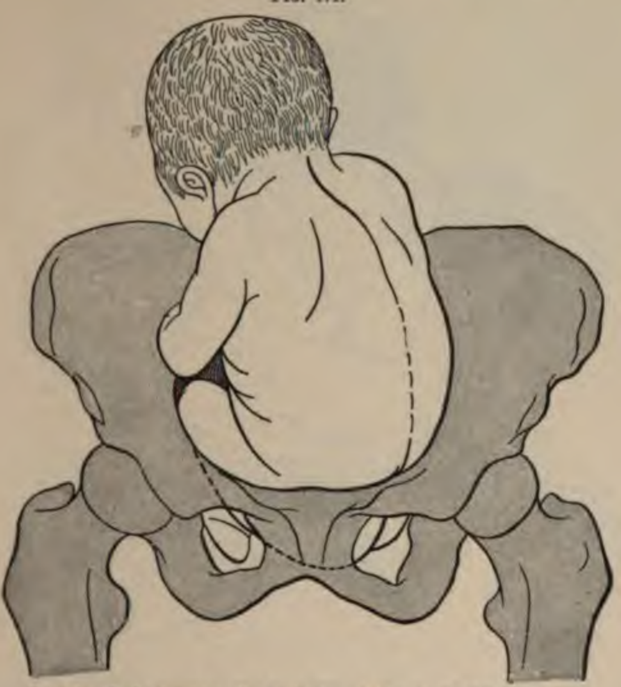
Face. Right mento-posterior position. (FARABEUF and VARNIER.)

FIG. 170.



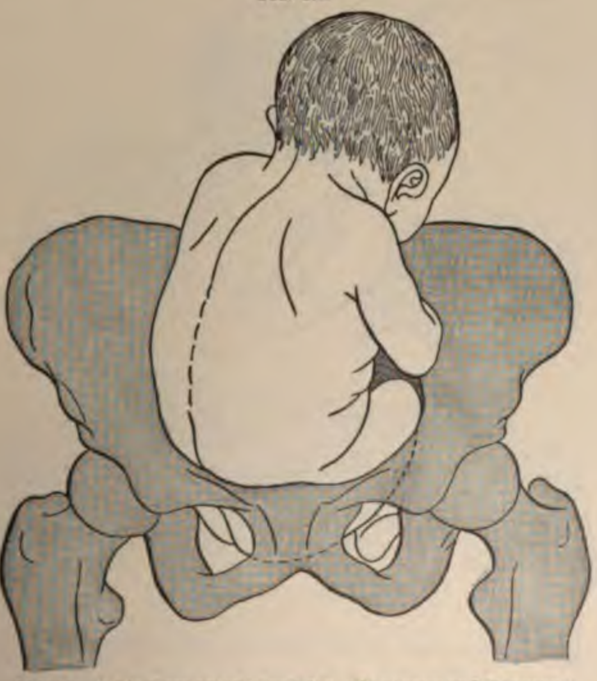
Face. Left mento-posterior position. (FARABEUF and VARNIER.)

FIG. 171.



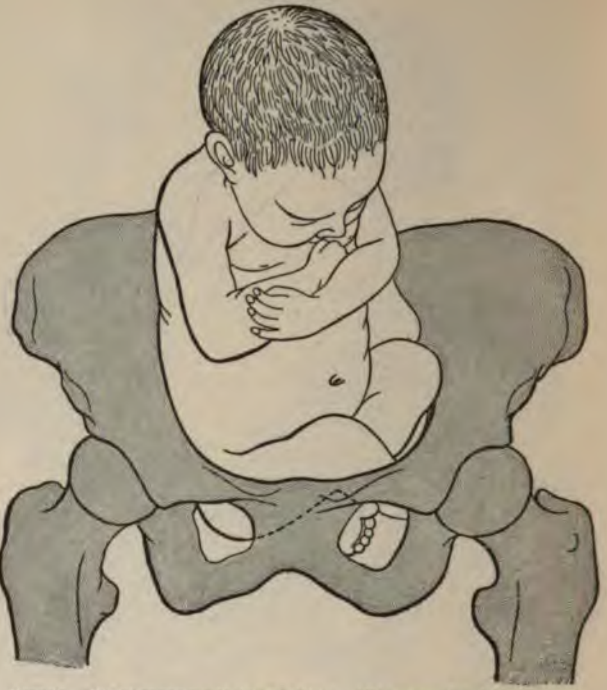
Breech Left sacro-anterior position. (FARABEUF and VARNIER.)

FIG. 172.



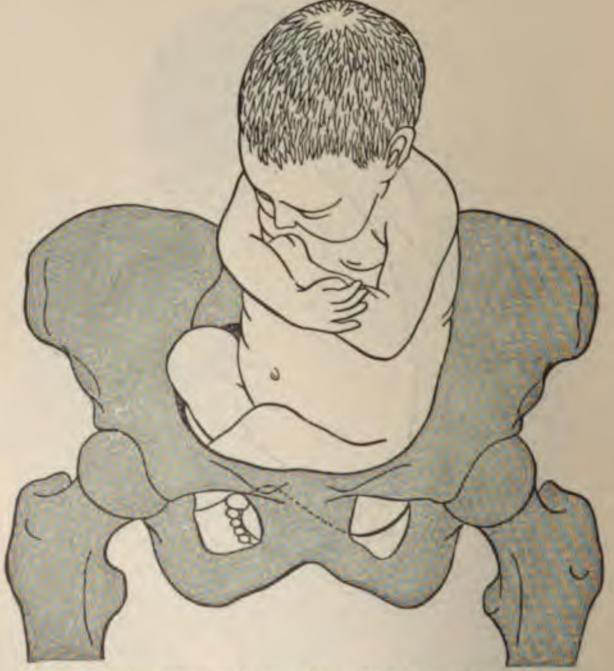
Breech. Right sacro-anterior position. (FARABEUF and VARNIER.)

FIG. 173.



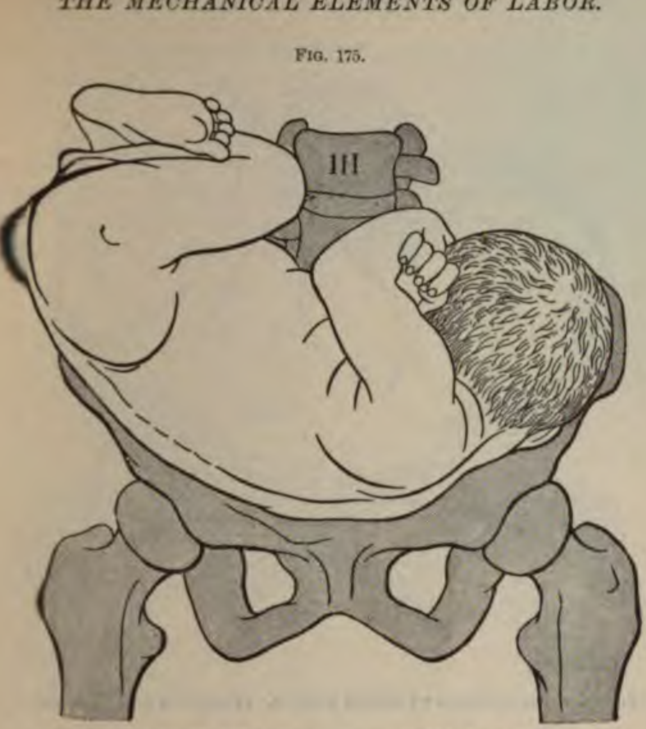
Breech. Right sacro-posterior position. (FARABEUF and VARNIER.)

FIG. 174.



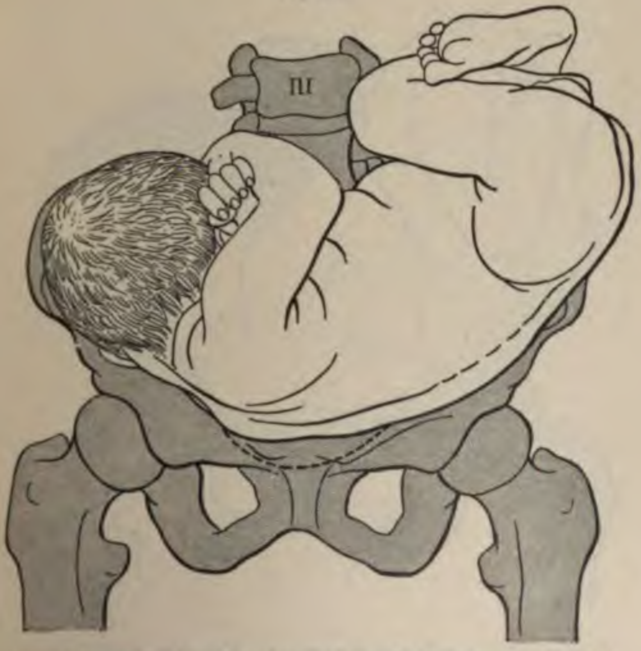
Breech. Left sacro-posterior position. (FARABEUF and VARNIER.)

FIG. 175.



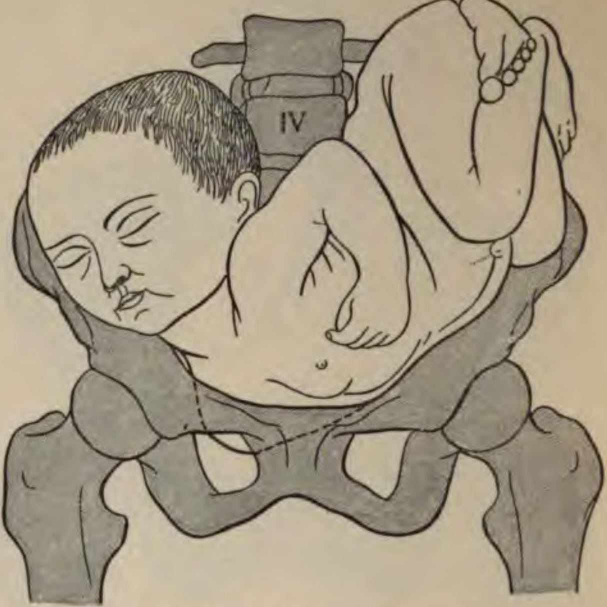
Shoulder. Left scapulo-anterior position. (FARABEUF and VARNIER.)

FIG. 176.



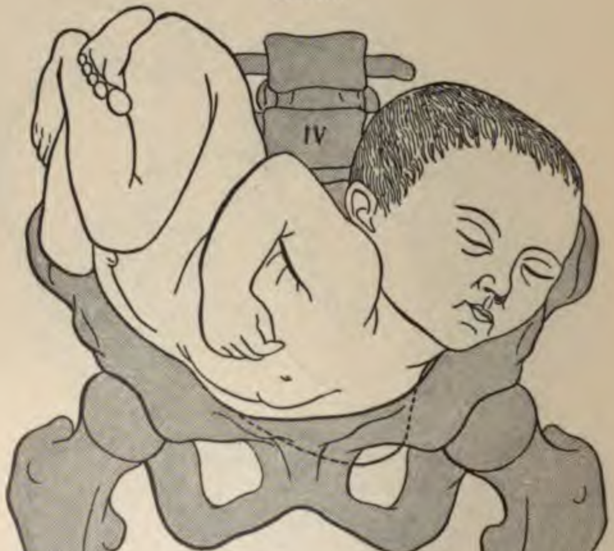
Shoulder. Right scapulo-anterior position. (FARABEUF and VARNIER.)

Fig. 177.



Shoulder. Right scapulo-posterior position. (Farabeuf and Varnier.)

Fig. 178.



Shoulder. Left scapulo-posterior position. (Farabeuf and Varnier.)

Posture, or the *attitude* of the fœtus, is the relation of the fœtal members to one another. The normal posture of the fœtus during pregnancy and parturition is one of flexion. The head is flexed, the arms are folded on the chest, the legs are flexed upon the thighs, and the thighs on the abdomen. The back is arched, and the fœtal mass presents an ovoid shape. The fœtal posture is the result partly of the primitive form of the embryo, mainly of the uterine pressure forces. As an element in the labor, posture is most important as relates to the head.

CHAPTER VIII.

THE MECHANISM AND CLINICAL COURSE OF NORMAL LABOR.

Definition of Normal Labor. The term eutocia is applied to labors which terminate without artificial aid and without injury to mother or child. All such labors are in a sense natural or normal, and in most obstetric text-books are so classified. In the present work the term *normal labor* will be restricted to labors in which there is no element of dystocia, those, in other words, in which all the mechanical elements are normal and which are not rendered dangerous to mother or child by complications independent of the mechanism. Under this definition only uncomplicated labors in which the vertex presents in anterior position will be classed as normal.

Stages of Labor.

Labor is divided into three stages:

The first stage, or stage of dilatation, ends with the full dilatation of the utero-cervical zone.

The second stage, or stage of expulsion, ends with the birth of the child.

The third stage, or placental stage, ends with the expulsion of the placenta and membranes and the complete retraction of the uterus.

The Duration of Normal Labor.

It is difficult to determine clinically the precise time when labor begins. For practical purposes, it is sufficient to date the onset of the parturient process from the time the woman is conscious of regularly recurring uterine contractions. In many instances, however, occasional pains are felt for days or weeks before labor is actively established. On the other hand, considerable dilatation is very frequently accomplished without pain. Sometimes the labor may cease wholly for a time after it has continued for several hours.

The time occupied by the process of dilatation varies greatly in different cases. Other things being equal, it is shorter in multiparæ than in primiparæ, since the soft parts offer less resistance after the first childbirth. It is especially prolonged in aged primiparæ, owing to excessive rigidity of the cervix uteri and of the pelvic floor in that class of parturients.

In typical normal conditions the average period from the beginning of active labor to complete canalization of the utero-cervical zone may be fairly stated at from ten to fourteen hours for primiparous and from six to eight hours for multiparous women.

The average length of the second stage is approximately two hours in the primipara and one hour in the multipara.

The expulsion of the placenta usually takes place within a period varying from a few minutes to two hours after the birth of the child. The average period is about twenty minutes.

Causes of the Onset of Labor.

A process like labor, involving so extensive coördinate muscular action, implies the existence in the nervous system of controlling motor centres for the regulation of the uterine contractions. Though it has been sufficiently established that there is such a centre in the medulla, from which impressions travel, probably down the cord and through the sacral plexus to the uterus, rhythmical contractions are not solely dependent on this centre, as is proved by the fact that contractions go on after connection with the medulla has been severed. For example, rhythmical contractions have been known to take place in the horn of a uterus which had been removed while labor was going on. In addition to the nerve centre in the medulla we have the cervical ganglion, an extensive plexus of nervous matter lying on the posterior vaginal fornix and intimately connected with the uterus by numerous filaments. It is formed by the union of nerve cords from the hypogastric plexus, and it receives filaments from the second, third, and fourth sacral nerves. Whether the motor impulses travel by the cord or pass by the path of the sympathetic trunk is a question that cannot be answered finally at the present time. Lusk and others have reported cases of successful labor in women having paralysis of the lower extremities, retention of urine, and incontinence of feces. Observations of this character would seem to show that the cord is not the only route by which impulses are transmitted. Charpentier says the influence of the spinal cord over uterine contractions cannot be denied, for in women who have paralysis, uterine contractions, if less painful, are also very feeble, and if a few such had easy deliveries, yet in the majority labor is tedious from feeble uterine contractions. Besides the centres just mentioned, Dembo found collections of ganglionic cells between the peritoneal and the muscular walls of the uterus and groups of cells lying in the anterior vaginal wall which he believes to be uterine motor centres. Jewett reports a case in which after a Cæso-hysterectomy the uterus, which was totally relaxed at the moment of amputation, contracted to a hard globe shortly after its removal from the abdomen.

Thus there are three motor centres which may give rise to contractions of the uterus—a centre in the medulla, the cervical ganglion, and a collection of ganglia in the anterior walls of the vagina and in the walls of the uterus. Of the relative importance of these centres we have no definite knowledge.

A great many theories have been advanced to account for the onset of labor, but none of them are entirely satisfactory, since none apply to all cases. All we can say at present is that labor is not the result of any one, but is due to the concurrent operation of a number of causes. These act by inducing uterine contractions, or perhaps it would be better to say by increasing the painless rhythmic contractions which are present in marked degree throughout the entire period of pregnancy. Among the probable causes of the active uterine contractions of labor the most important are the following:

1. Loosening attachment of the ovum, converting it into a foreign body.
2. Excess of carbon dioxide in the blood.

3. Distention of the uterus by the growing ovum.
4. Mental impressions.

1. Loosening Attachment of the Ovum. Separation of the *decidua vera* begins with the first active contractions of the uterus. The separation may be the result of a number of contributing factors; for example, fatty degeneration of the decidua has been observed in the latter part of pregnancy; but this is not constantly found. Simpson held that it occurred in the fourth month of pregnancy.

The *decidua vera* is divided into two parts. One part consists of an outer, dense, membranous layer of large cells resembling pavement epithelium; the other part, of a layer of much looser texture in which are found the large decidual glands. It is in this spongy layer that the separation of the decidua takes place. In this layer toward the end of pregnancy the trabeculæ enclosing the spaces of the network have been observed to decrease in size from $\frac{1}{500}$ of an inch to $\frac{1}{2500}$ of an inch. The layer seems to shrivel and thus to permit easy separation. The occurrence of hemorrhages, the result of the compression and tearing caused by the violent uterine action, also tends to detach the ovum from the walls of the uterus, and may act to intensify the pains already established. This separation of the decidua from the uterine wall makes the ovum in part a foreign body, and this explains the continuance of the expulsive efforts.

2. Excess of Carbon Dioxide in the Blood. Brown-Séquard has shown that excess of carbon dioxide in the blood of pregnant animals will bring on uterine contractions. This effect may be produced directly or through the uterine motor centre. As the fœtus grows, it demands more nutriment, and there must be a corresponding increase of the products of tissue waste, including carbon dioxide. The presence of carbon dioxide in the blood of the placenta is accounted for in several ways, but many of the explanations agree in this, that it is the result of some interference with the passage of the blood through the placenta. Leopold and Ruge believe it to be due to the formation of thrombi in the placenta. Friedländer explains the formation of blood coagula in this organ by the penetration into the uterine sinuses of the cells that form in the serotina about the eighth month. Another explanation of the increase of the carbon dioxide is based on the fact that the trabeculæ of the sinuses are observed to decrease until, at the end of pregnancy, they are about one-fifth their former size. This may be the result of cell infiltration of the walls and consequent contraction. When the venous blood has accumulated to a certain amount the contained carbon dioxide stimulates the uterine contractions, and labor is established.

3. Distention of the Uterus. The growth of the gravid uterus is a result in part of development of the uterine muscularis, in part of distention of the uterine parietes. There is not only hypertrophy and hyperplasia, but as well, it is assumed, a rearrangement of the muscular fibres, so that, instead of lying side by side, they are disposed more nearly end to end. When the limit is reached and growth and extension can go on no further, then labor begins.

Power likened the evacuation of the uterus to the emptying of viscera such as the bladder and the rectum. These permit distention to a certain extent and then expel their contents.

4. **Mental Impressions.** It is only necessary to mention the effect of great grief as an etiological factor in abortion to call to mind how important a part the emotions may play in inducing labor. But such agencies as these and slight muscular strains, jars, and falls happening at the close of gestation, and the descent of the fœtus low in the pelvis, due to yielding of the cervix, cannot be viewed as essential causes of the onset of labor. The establishment of labor is often wholly independent of such influences.

In the existing state of our knowledge it is impossible to say which of the many possible causes are most active in bringing about the final result.

THE CLINICAL PHENOMENA OF BEGINNING LABOR.

The more important phenomena of labor are those which pertain to the uterus. These will next be considered.

Labor Pains. Contractions of the uterus occurring during labor are known in all languages by the word which expresses pain. Labors unattended with pain have been recorded, but they are exceedingly rare. It is also said that patients have been delivered in a condition of hypnotic sleep, but such experiences are among the rarer curiosities of obstetric practice. The cause of the painful sensations in the early part of labor is the distention of the cervix, and in the latter part the suffering is due to stretching of the vagina and vulva and to compression of the nerve-trunks in the pelvis.

Bearing in mind that the uterine musculature is a collection of non-striated muscular fibres, it may be expected to manifest the same kind of activity that is observed in this variety of muscular tissue in other parts of the body.

The contractions are *involuntary*. The patient cannot initiate them nor can she stop them when they have begun, although in the stage of expulsion she can assist them by voluntarily bringing the abdominal muscles into play. Notwithstanding the automatic character of the uterine contractions, mental impressions may affect them in a marked degree; for example, the arrival of the physician may retard, and even for a short time arrest, the labor. The pains are likely to be inhibited, too, by the reflex effect of a full bladder or rectum.

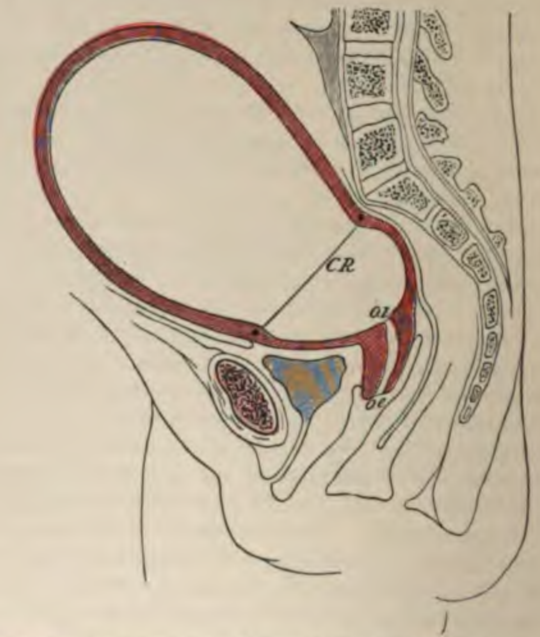
The pains are *intermittent*, and the interval between them varies with the stage of progress. The intervals of repose grow shorter as the labor progresses, until finally, at the end of the second stage, the expulsive efforts are almost continuous. The intermittent character of the pains is essential to the safety of the fœtus. During the height of a uterine contraction the placental circulation is almost wholly interrupted, and the fœtus, moreover, suffers powerful compression. Under persistent uterine contraction it would soon perish.

The contractions are *peristaltic*, proceeding from one extremity of the uterus to the other. The direction of this contraction wave is from fundus to cervix. In some of the lower animals contractions have been observed to pass from cervix to fundus, but such phenomena are doubtless exceptional and abnormal. The wave is said to last from one-third to two-thirds the length of the labor pain. Assuming that the average duration of a pain is one minute, the peristaltic wave would last from twenty to forty seconds.

THE MECHANISM OF DILATATION.

Upper and Lower Uterine Segments. The gravid, like the non-gravid uterus, presents two general divisions, the body and the cervix. The body of the parturient uterus, however, resolves itself into two parts, designated respectively the upper and the lower uterine segment. The plane which separates the two segments lies nearly at the level of the utero-vesical fold of peritoneum. This plane represents the level at which the conical lower portion of the cavity begins to be smaller than the greatest sectional plane of the fœtal head which must pass through it. The lower uterine segment, therefore, comprises all that portion of the body of the uterus which, together with the cervix, must undergo dilatation preparatory to the expulsion of the fœtus. The upper uterine segment includes approximately the upper two-thirds of the entire length of the uterus; the lower segment and the cervix, which are of nearly equal lengths at the beginning of labor, constitute the remaining third. Fig. 179.

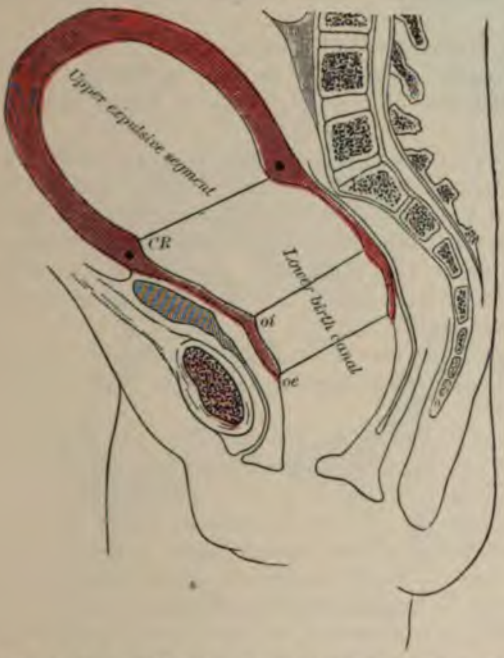
FIG. 179.



CR. Contraction ring, or retraction ring, at onset of labor. *oi.* Os internum. *oe.* Os externum. (SCHROEDER.)

Uterine Retraction. During labor the expellent force obviously must be supplied by the contractions of the upper uterine segment. The lower segment is concerned in dilatation, and after dilatation is fully established it has become entirely passive. The dilatation which takes place in the cervix and the lower uterine segment as the upper segment contracts is a phenomenon somewhat comparable to what occurs in other hollow viscera during the expulsion of their contents. It is in part a relaxation and in part the result of distention.

FIG. 180.



Retraction ring at end of first stage of labor. Lower birth canal consists of the lower uterine segment and the cervix. (SCHROEDER.)

oe. Os externum. *oi.* Internum. *CR.* Contraction or retraction ring.

After labor is established the musculature of the upper uterine segment becomes thickened, and that of the lower segment as it dilates is correspondingly thinned. The line of demarcation between the thickened upper and the thinned lower segment presents a ridge which often may be made out on palpation over the abdomen during a pain. Fig. 180. This ridge is called the ring of Bandl, from the name of the authority who first described it. It is also known as the contraction or the retraction ring. The latter is, perhaps, the preferable term. The situation of the retraction-ring, which at the onset of labor is below the pelvic brim, rises higher as the pains go on, and in abnormally long or obstructed labors may reach nearly the level of the navel. The term retraction applies to the process by which the thickening takes place in the upper segment. It is due mainly, if not wholly, to persistent shortening and thickening of the muscular fibres. While the shortening of the muscular fibres which occurs during the uterine contractions is followed by elongation in the intervals, the primal length is not fully restored. It is commonly taught that retraction is due in part also to a rearrangement of the muscular fibres. Fibres, it is assumed, which at the beginning of labor lie nearly end-to-end, in course of retraction, come to lie nearly side by side. The retraction of the upper segment of the uterus increases as the volume of its contents is diminished. The retraction, in other words, progresses in proportion to the progress of the birth and the upward movement of the retraction-ring.

Dilatation of the Cervix. In the dilatation of the cervix three agencies are concerned:

1. Softening of the cervical tissues.
2. The hydrostatic pressure of the bag of waters.
3. The contraction of the longitudinal fibres of the upper uterine segment.

1. Progressive softening of the cervix, commencing below and extending upward, is normally present from the early months of pregnancy, and is a valuable sign of this condition. Contractions of the uterus, by interfering with the return circulation, cause over-distention of the cervical veins and lymphatics, and there is an infiltration of the tissues with serous exudate; at the onset of labor the infiltration and softening increase rapidly.

The yielding of the cervix in the first stage of labor is doubtless in part a physiological relaxation analogous to that which takes place in sphincter muscles.

2. Hydrostatic Pressure of the Bag of Waters. The second agency in securing dilatation—pressure from the bag of waters—is a very important one. Its value is most clearly brought to our attention when we have lost it. If, by mischance, early rupture of the membranes has occurred, and the waters have drained away, the labor is termed a dry labor. Such labors are proverbially liable to be of long duration and may be prejudicial to mother and child.

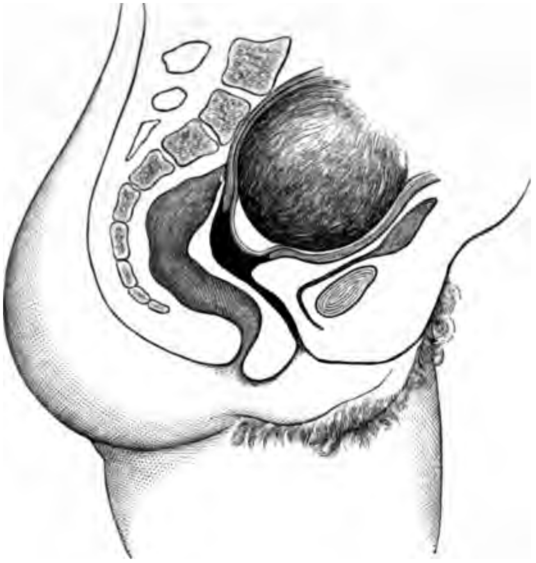
During a uterine contraction, as the cervix opens, the lower portion of the membranes, loosened from its attachment by the first active uterine contractions, insinuates itself into the opening. Since the fluid within the membranes transmits the force of the uterine contraction equally in all directions, the bag of waters is distended laterally as well as downward, exerting an expansive pressure directly upon the walls of the cervix. The lateral expanding force acts in the radii of the resisting ring. Other things being equal, the hydrostatic pressure increases with the area of the surface on which it acts. The dilating force becomes greater, therefore, in proportion as the dilatation progresses. Fig. 180.

With premature rupture of the membranes we lose the efficient hydrostatic wedge, and have in its place the head. This substitutes a body almost unyielding in its nature for the water-bag. The former is inferior in dilating power to the equable hydrostatic pressure of the bag of waters, but moulding and the caput succedaneum, yet to be described, add somewhat to the sharpness of the dilating wedge. They compensate in some degree for the loss of the hydrostatic pressure of the sac of waters.

3. Action of the Longitudinal Muscular Fibres of the Uterus. While the membranes are unruptured the contents of the uterus are practically incompressible. We may imagine a uterus containing an absolutely incompressible body of a similar shape to the ovum. It is obvious that the pull of the contracting longitudinal muscular fibres

of the upper uterine segment will act to drag the lower segment and cervix upward over the contained body. The oblique muscular bundles act in some degree with like effect. It must be remembered, too, that the circular bundles are not so strong in the cervix as in the fundus. The muscular structure of the lower segment is thinner and weaker than that of the upper segment.

FIG. 181.



Bag of waters during a pain.

Another explanation of the dilating mechanism which has been offered is the following: When a wave of contraction passes from one end of the uterus to the other, it must pass through the length of the longitudinal fibres and across the circular fibres. It is suggested that the contraction wave traverses the longitudinal fibres more rapidly than it affects the circular fibres. If this is true, the wave passing through the longitudinal fibres would reach the cervix before that affecting the circular fibres, and would draw the cervix over the presenting part while the circular fibres of the lower segment are at rest.

The Cervical Rings. The first effects of the dilating force are observed at the internal os. This expands with the pains, and for a time contracts again in the intervals. As the dilatation progresses the os internum becomes permanently relaxed. A digital examination at this time reveals two distinct resisting rings, one at the external and one at the internal end of the cervical canal. The canal itself preserves a pronounced fusiform shape. Later, the os internum becomes permanently obliterated, having merged into the lower uterine segment. The ovum from this time rests upon the external ring or the os externum. This is gradually expanded as the labor goes on, till finally the walls of the dilated utero-cervical zone and those of the vagina form one continuous canal, with a barely perceptible interruption at the external ring of the cervix uteri.

Retraction of the Pubic Segment of the Pelvic Floor. Toward the close of the first stage and during the earlier part of the second, as the cervix is drawn upward over the head, the bladder is lifted partly above the pubic bone by the traction of the longitudinal muscular fibres of the uterus. The bladder is thus in some measure protected from injury by the pressure of the head as it traverses the pelvic canal.

THE CLINICAL PHENOMENA OF THE FIRST STAGE.

The Pains. The patient realizes that she is in labor when she begins to suffer regularly recurring pains in the back. From this region the pains may radiate around to the front and, perhaps, be felt running down the thighs.

The initial labor pains most frequently come on in the early part of the night. They at first recur at intervals of about thirty minutes, but as the labor goes on the intervals become progressively shorter.

The pains differ little in character from the so-called false pains frequently experienced during the later weeks of pregnancy, but they are distinguished by a more or less rhythmical recurrence and by growing strength and frequency.

The painful character of the uterine contractions of labor is probably due in great part to the stretching of the cervix. The pains are sharp and "nagging." The patient walks restlessly about the room, sits in a chair, or at times takes to the bed. If she is on her feet when a contraction begins, she bends over a chair or other object near at hand. Her face during the pains is congested, owing to fixation of the respiratory muscles. Reflex vomiting is not infrequent as the dilatation becomes nearly complete. Its occurrence may usually be taken as evidence that the first stage of labor is well advanced.

The uterine contraction of labor presents *three stages*—a period of increase, a period of acme, and a period of decrease. The stage of acme lasts longer than the other stages, and the increase is longer than the decrease. The length of the acme differs somewhat at different stages of labor.

The *force* of the contraction has been estimated by different methods, none of which is entirely satisfactory. Attempts have been made to estimate the stress necessary to rupture the membranes, and, by placing a bag of water in the uterus in front of the advancing head, to determine how much tension is sustained by the contents of the bag during a pain. According to Duncan and Poppel, the membranes rupture under a pressure ranging between four and thirty-seven and a half pounds. Schatz, by the aid of a manometer, estimated the resistance overcome by the advancing head to be between seventeen and fifty-five pounds. We have as yet, however, no reliable means of determining the force exerted in expelling the child.

The *degree of pain* is variable. The pains of dilatation are often not so well borne as those that come later, because the parturient is impatient of suffering which seemingly results in no progress. The pain caused by the passage of the head over the pelvic floor, if not relieved by an anæsthetic, is usually the most intense.

The Show. By expansion of the cervix and the lower uterine segment, the membranes in the lower part of the uterus are separated from the uterine wall, causing a slight discharge of blood known as the show.

The cervical and the vaginal secretions become more profuse as labor is established. They serve as a lubricant to the passages in preparation for the expulsion of the fœtus.

The irritability of the bladder and the rectum already established by the lightening, is increased when active pains begin. Urinary and fecal evacuations occur more frequently than before.

The cervix becomes thin and sharply defined during the pains. In multiparæ the lower part of the cervix is more patulous, and offers less resistance to the advancing bag of membranes than in primiparæ.

The Pulse. The maternal pulse becomes more rapid during a pain; the heart-tones of the fœtus are less distinctly audible, and the pulse-rate is slower than in the intervals. The fall in the fœtal pulse-rate is due to increased vascular tension caused by the compression to which the fœtal mass is subjected during a uterine contraction.

Rupture of the Bag of Waters. When the cervix has become well dilated, rupture of the membranes may occur. It may take place at an earlier period, or may not happen till the end of the stage of expulsion. Very rarely a full-term child may be born with the membranes unbroken.

Rupture of the bag of waters is announced by a gush of water from the vagina. The quantity of liquor amnii expelled will depend on the extent to which the lower uterine segment is occluded by the presenting part. It is not always safe to rely on the patient's statement that the membranes have ruptured. She may be misled by leakage of urine from the bladder. If the discharge is due to rupture of the membranes there is usually more of it between than during the pains, since the head then recedes and allows the waters to escape. Sometimes an accumulation of fluid has taken place between the amnion and chorion, and this may escape by rupture of the chorion, the amnion still remaining intact. It is claimed that amnial liquor may transude through the unbroken membranes.

Emotional Influences. The progress of the labor in this stage is easily influenced by emotional causes. The presence of a strange face or the narration of the horrors of previous cases by friends or by the nurse may stop the pains for a long time. After the membranes give way the uterus retracts as the waters escape, and the pains are resumed with new vigor.

The *bearing of the patient* differs greatly in different women; some apparently suffer very little, and others complain bitterly.

The Mechanism of Expulsion.

The "mechanism of the second stage of labor" concerns especially the movements which the fœtal head and the trunk undergo in course of their transit through the birth-canal. Since the head-diameters are larger and less compressible than are those of the trunk, the mechanism is most important as relates to the head.

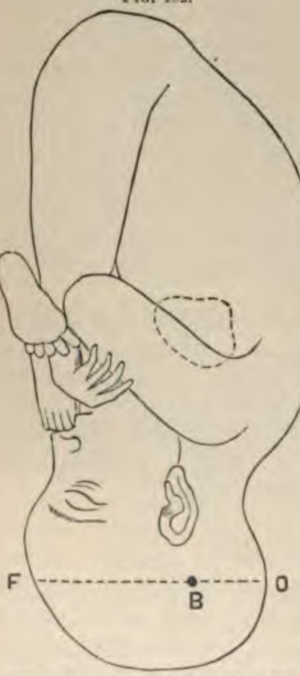
1. The head movements are: Descent, flexion, rotation, extension, restitution, external rotation.

Descent. During the first stage of labor, as has been seen, the force of the uterine contractions is expended in dilating the utero-cervical zone. At the beginning of labor, if the membranes are intact, the intra-uterine pressure developed by a uterine contraction is, in accordance with the familiar law of hydrostatics, brought to bear upon the fœtus equally in all directions. After partial dilatation of the cervix and the formation of the bag of waters the head sinks into and partially occludes the lower uterine segment. Under the pressure developed in the hindwaters during a uterine contraction the head advances as the sac of forewaters protrudes. After the membranes rupture the head descends with a moving force which is measured by the propelling power less the resistance opposed by the birth-canal.

So long as the waters have not all escaped, the expellent force is transmitted to the head, in part, sometimes wholly, through the liquor amnii. After the waters have drained away the fœtal parts are consolidated in a compact mass by the grasp of the uterus, and, the fundus contracting directly upon the breech, the propelling force is transmitted in great measure through the entire fœtal ellipse. The lateral compression exerted by the uterine contractions acts to steady the fœtal mass and adds also somewhat to the extruding force.

Flexion. Flexion is in part primary, being the normal posture of the fœtus *in utero*. It is increased when the head begins to encounter the resistance of the lower uterine segment, and becomes complete after engagement in the bony pelvis. The mechanism is as follows: The head is so attached to the trunk that its sincipital is longer than its occipital pole. The head, in other words, corresponds to a lever of unequal arms, the occipito-atlantoid articulation being the pivotal point and the sincipital arm the longer arm of the lever. Fig. 181. When the head begins to encounter the resistance of the birth-canal this resistance, even though equal at the two poles, must act with greater effect on the long arm of the lever. This advantage in normal conditions is increased by the primary flexion. The chin, therefore, dips toward the sternum. The flexion is increased as the opposing forces increase, and becomes complete when the head meets the resistance of the bony walls of the pelvis.

FIG. 182.



Illustrating the different lengths of the frontal arm, F B, and the occipital arm, B O, of the lever presented by the fœtal head.

Another factor in bringing about the flexion of the head is to be found in the tendency of the cephalic ellipsoid to adapt itself to the shape of the canal through which it descends. Under the pressure of the pelvic walls the long axis naturally falls into relation with the axis of the birth-canal.

The advantage of flexion is obvious. It brings the smallest, or sub-occipito-bregmatic, circumference of the head in relation with the girdle of resistance in place of the larger occipito-frontal circumference.

As has been stated, the head enters the brim fully flexed, or it soon becomes so under normal circumstances; thus all motion in an antero-posterior direction is checked, but some degree of lateral mobility still remains. A great deal of discussion has arisen with reference to the question whether the head inclines laterally to one side or the other during its passage through the brim. Naegele and Dubois hold that the anterior parietal bone dips deeper in the pelvis than the posterior, bringing the sagittal suture nearer to the promontory than to the symphysis. This lateral obliquity of the head is termed asynclitism. When the head descends with its planes parallel to those of the pelvis the descent is said to be synclitic. Küneke and most other authorities believe that synclitism is preserved till delivery takes place. In labor in deformed pelves the obliquity of Naegele is present in some degree.

Rotation. When the head reaches the pelvic floor the long diameter of the head which passed the brim in a direction parallel with the oblique diameter of the pelvis begins to turn till at the moment of expulsion it is nearly parallel with the antero-posterior diameter of the pelvis, the occiput normally swinging to the front.

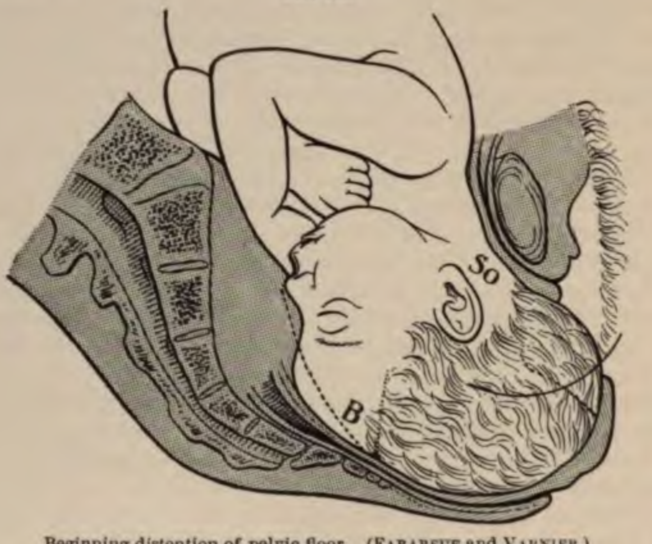
The chief agency in bringing about the rotation of the head as it traverses the pelvis is the action of the pelvic floor. The floor of the pelvis may be considered as made up of two lateral halves, each of which slopes downward, inward, and forward. That pole of the fœtal head which lands first on one lateral half of the floor glides downward, inward, and forward, and emerges from the outlet beneath the pubic arch. When the head is normally flexed the occipital pole first reaches the floor of the pelvis, and, as it descends, is rotated inward to escape under the arch of the pubes. It will be noted that flexion is a prerequisite to rotation. It is only when the occipital pole of the head dips lower in the pelvis than the sincipital that anterior rotation of the occiput is likely to prevail. Should the sinciput reach the pelvic floor at the same time as the occiput the former may be rotated forward under the symphysis, the latter going backward into the hollow of the sacrum.

The influence of the planes or grooves of the bony pelvis, on which stress has been laid by certain obstetric writers, is of secondary importance in effecting rotation of the head. That the action of the pelvic floor is the principal agency in causing rotation would seem to be sufficiently established by the experiment of Dubois. Dubois showed that when the head of a fœtus is pushed through the pelvis of a woman who had died before or immediately after delivery, no matter in what position we place the occiput, if it strikes the pelvic floor in advance of the sinciput, it will turn forward, provided the floor has not been injured by rupture or overstretching. The repetition of the experiment will, if too often repeated, overstretch the floor and then rotation will fail.

Edgar, of New York, screwed a swivel into the head of a fœtus half an inch behind the small fontanelle. Attaching a cord to the ring of the swivel, he repeatedly dragged the head through the pelvis of a woman dead after recent delivery. The occiput invariably rotated to the front, even when the head entered the pelvis in occipito-posterior position, so long as the pelvic floor retained its integrity. When the tonicity of the floor became impaired by overstretching, the head traversed the pelvis in very nearly the same position as it had entered.

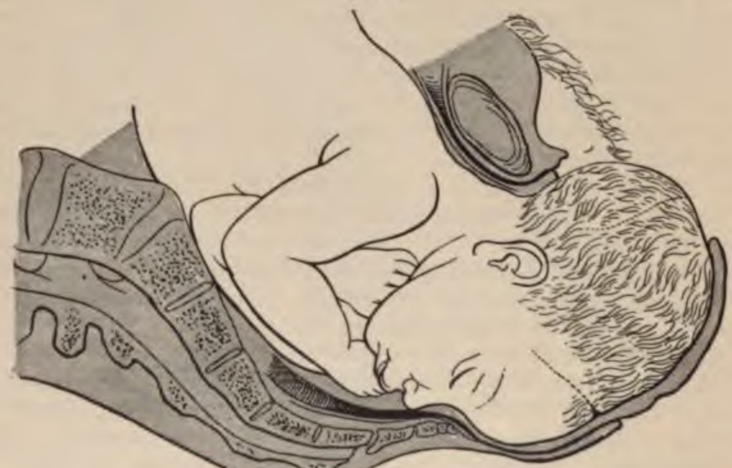
After the leading pole begins to pass the lower end of the symphysis its forward rotation is favored by the fact that this direction is that of least resistance.

FIG. 183.



Beginning distention of pelvic floor. (FARABEUF and VARNIER.)

FIG. 184.

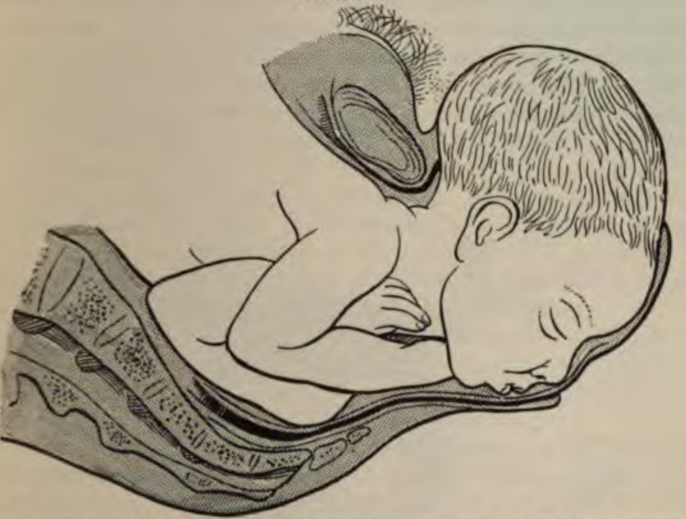


Beginning extension of head. (FARABEUF and VARNIER.)

Extension. By the time the occiput is about to emerge under the pubic arch the sinciput rests firmly upon the coccyx and lower portion of the sacrum. The biparietal diameter lies in the grasp of the ischial tuberosities and the vertex distends the pelvic floor. Fig. 183. The long diameter of the head lies nearly in line with the sacro-pubic diameter of the pelvis.

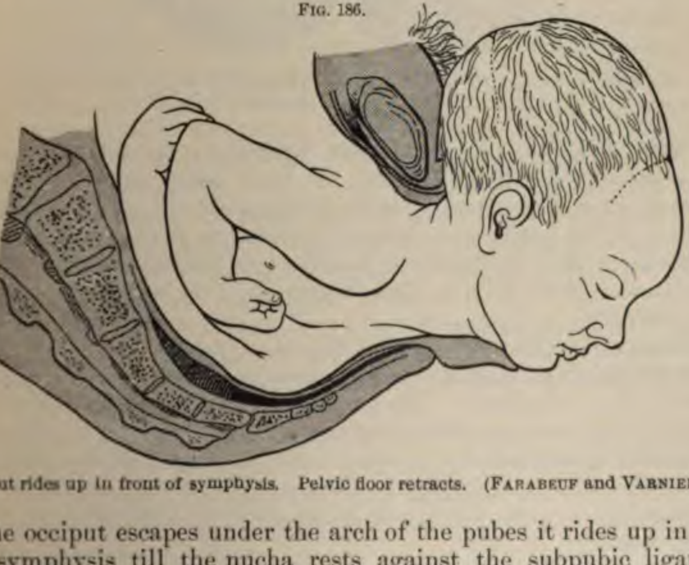
As the head is driven down the distention of the pelvic floor is ncreased. The floor grows progressively thinner as it stretches under the pressure of the advancing head, and becomes more and more elongated antero-posteriorly till at the moment of expulsion the length f the sacral segment, from coccyx to the posterior edge of the vulva, 6 inches.

FIG. 185.



imum distention of pelvic floor. Equator of head about to pass. (FARABEUF and VARNIER.)

FIG. 186.



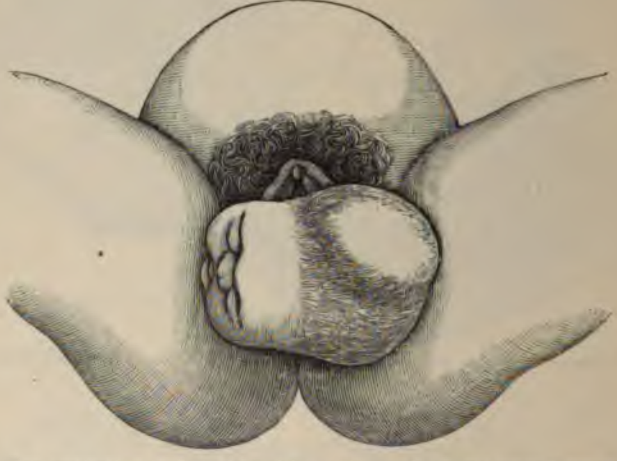
Occiput rides up in front of symphysis. Pelvic floor retracts. (FARABEUF and VARNIER.)

s the occiput escapes under the arch of the pubes it rides up in front the symphysis till the nucha rests against the subpubic ligament. head is then expelled mainly by descent in the line of the birth- al, partly at the last moment by a movement of extension, the tex, the forehead, and the face successively sweeping over the free e of the sacral segment of the pelvic floor. Figs. 184, 185, and 186.

Throughout its descent the head advances with the pains and recedes in the intervals. In normal conditions this alternate advance and recession continues during expulsion till the head is well in the grasp of the vulvo-vaginal ring. From this time no recession takes place between the pains.

Restitution. The rotation of the head in course of its transit through the pelvis develops a certain degree of torsion of the neck. As the head is expelled the neck untwists. The head, therefore, immediately it is born, assumes a position corresponding to that in which it had entered the pelvis. This movement is termed restitution. It is of interest for the reason that it indicates the primary position of the head. Fig. 187.

FIG. 187.



Fœtal head after restitution in L. O. A. position. Shows also caput succedaneum. (RIBEMONT-DESSAIGNES and LEPAGE.)

External Rotation. The shoulders descend in the oblique diameter of the pelvis opposite that in which the head came down. They rotate, therefore, in a direction opposite that which the head had pursued. Rotation of the head is accordingly continued during the expulsion of the shoulders and in the same direction as that which obtained in the movement of restitution. This supplementary rotation is termed *external rotation.*

Delivery of the Trunk. The shoulders engage in the oblique diameter of the pelvis opposite that in which the head entered. They rotate less perfectly than the head. The anterior shoulder is arrested behind the symphysis and the posterior shoulder rides over the pelvic floor and, as a rule, first appears at the vulva. After expulsion of the posterior, the anterior shoulder is disengaged and escapes. The breech undergoes only partial rotation. As the trunk is expelled it is followed by a gush of bloody water.

CLINICAL PHENOMENA OF THE SECOND STAGE.

If the patient is very much fatigued from a long first stage she may sleep between the pains. These brief periods of rest help to renew her strength and add to the efficiency of the pains. The parturient is much more likely to sleep if chloral has been administered in the first stage.

The pains are more severe during the stage of expulsion, but the patient realizes with a sense of satisfaction that the head advances with the pains, and the hope of speedy relief fortifies her endurance.

When the occiput has reached the pelvic floor, the cavity of the pelvis is completely filled and the pressure of the head gives rise to marked rectal tenesmus. The sphincter ani becomes relaxed and one or more fecal evacuations usually take place as the head passes over the floor of the pelvis. The contractions of the abdominal muscles toward the close of the expulsive stage are reflex and wholly involuntary. As the head distends the vulvar ring the pains become so intense as sometimes to result in transient delirium.

A brief pause ensues on birth of the head. After a moment or two of rest, contractions recur and the shoulders pass; then the body, followed by a gush of bloody amniotic fluid, is expelled.

The second stage is now ended, and a period of a few moments follows before the pains are again renewed to expel the afterbirth.

Moulding of the Head. Even in typical normal labors, the head undergoes more or less alteration in shape as it is driven into the pelvic brim. This is an important fact in the mechanism of labor, since it conduces in marked degree to the adaptation of head to pelvis.

Under the influence of the pelvic pressure forces the diameters in the grasp of the resisting girdle are all reduced, this reduction being compensated by elongation of the cephalic mass in the direction of the birth-canal. The engaging diameters are thus diminished to the average extent of 6 mm., ¼ inch. The degree of moulding will obviously depend on the relative size of head and pelvis and the plasticity of the cranial vault. The plasticity varies with the extent of ossification, which is not absolutely constant at the same stage of development.

Moulding is an essential element in the mechanism of the expulsive stage of labor not only by reason of adaptation of head to pelvis, but also because elongation of the head favors normal rotation by increasing the dip of the leading pole.

Caput Succedaneum. The caput succedaneum is an œdematous swelling which is developed on the presenting part in course of the birth. It is formed after rupture of the membranes. During a uterine contraction all parts of the fœtal mass are under pressure except that which offers to the examining finger within the girdle of resistance. The vessels of the presenting part become engorged during the pains and a serous exudate takes place into the cellular tissues of that portion of the fœtal surface. See Fig. 187.

The size of the caput succedaneum will obviously vary with the degree of force which produces it. It is large, therefore, in prolonged and difficult labors. Its size affords a valuable sign in the vaginal examination of the degree of obstruction which the fœtus encounters in its passage through the pelvis.

The location of the caput succedaneum is of interest in the examination of the head after delivery as indicating the position in which the head had descended. In anterior positions it is situated at the posterior, and in posterior positions on the anterior aspect of the summit of the head. In left positions it occurs to the right, and in right positions to the left of the median line. A right occipito-posterior location of the caput, therefore, indicates a left occipito-anterior position of the head, and so on.

It should be remembered that the situation of the tumor may be modified when the head has been subjected to long-continued pressure in the lower portion of the birth-canal after partial rotation had taken place.

The caput, like moulding, by adding to the elongation of the leading pole of the head, promotes rotation. In labors in which the head furnishes the dilating wedge it adds to the efficiency of the dilator by increasing the acuteness of the wedge.

A similar swelling develops on the presenting part in other than cephalic presentations. To this it is customary to apply the same term on whatever part of the fœtal surface it occurs. The tumor usually disappears within twenty-four hours after birth.

THE MECHANISM OF PLACENTAL EXPULSION.

After expulsion of the child the uterus grows smaller by retraction and closes about the placenta. When active contractions are again resumed the placenta is gradually detached. As the seat of placental attachment shrinks during a uterine contraction, the placenta not being sufficiently retractile to accommodate itself fully to the diminished area of the placental site, it is partially torn from the uterine wall with each pain. Rarely it may happen that the placenta is wholly separated by the first strong contraction. The placenta will then probably be forced out folded on itself from side to side, presenting by its edge.

If the placenta is not wholly detached at the first expulsive efforts, a different mechanism may obtain. Detachment sometimes takes place first over the central portion of the placental seat. Then, as the uterus relaxes, a retro-placental blood clot is formed. With each succeeding contraction the area of detachment is increased and the clot grows accordingly. The liberated portion of the placenta is thus thrust downward toward the cervical opening and the afterbirth is expelled flatwise by its amniotic surface.

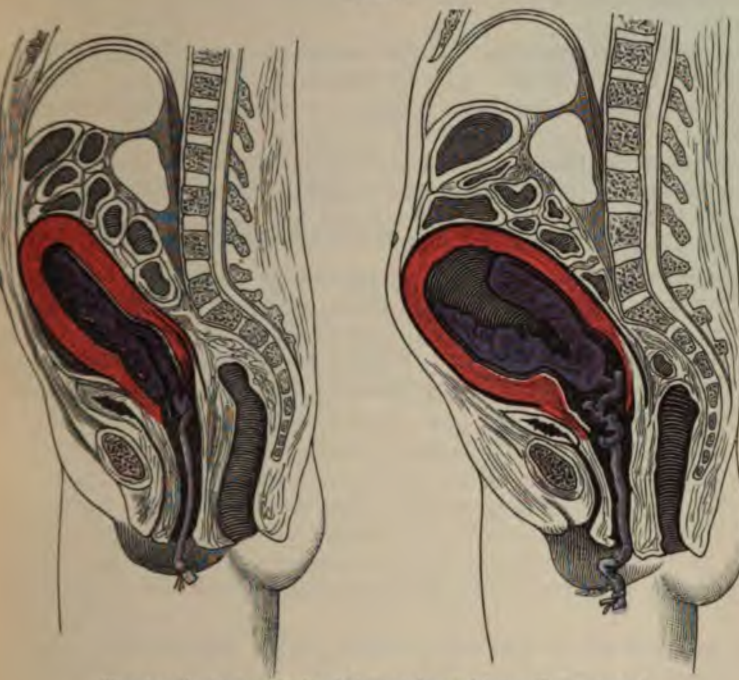
When it is extruded, with its edge presenting, the grasp of the uterus acts directly upon the placenta. When it is dissected off by the blood clot its expulsion is partly due to the extruding force propagated through the retro-placental blood clot during the uterine contractions. Figs. 188 and 189.

The membranes are last to be detached. In either method of expulsion the placenta is thrust downward through the rent in the membranes and the latter are peeled off by traction of the placenta.

It is obvious that the passage of the placenta with its long diameter corresponding to the long diameter of the uterus is most favorable to easy expulsion.

Persistent adhesion of the membranes may prevent the placenta from being delivered with its long diameter in conformity with the long diameter of the uterus. Pulling on the cord, by pulling down the central portion of the placenta, may act with like effect.

FIG. 188.



Showing the two methods of placental expulsion. (SCHROEDER.)

THE CLINICAL PHENOMENA OF THE THIRD STAGE.

At a variable length of time after the child has been delivered the uterus again commences to contract, the placenta is gradually forced into the vagina, and, when the muscular tonicity of the pelvic floor has not been too much impaired, may be expelled from the vulvar orifice. The membranes are dragged after it, sometimes promptly, sometimes peeling slowly from their uterine attachment.

The expulsion of the placenta is accompanied with a greater or less amount of clotted and of liquid blood. The total quantity of blood lost during the third stage, together with that expelled at the birth of the child, should not, in strictly normal conditions, exceed a pint.

After-pains. After the expulsion of the placenta there is a pause of variable length in the uterine contractions. The contractions of this period are termed after-pains. They are not usually painful in primiparæ. In multiparæ they are frequently violent enough to cause considerable distress. Severe after-pains are due, as a rule, to the retention of blood-clots in the uterus. This occurs more frequently in women who have borne children, owing to the greater relaxation of the multiparous uterus. In the presence of clots the uterine contractions become more powerful in the effort to expel them.

Retraction of the Uterus. Normally the after-pains serve a useful purpose. They bring about retraction, by which the active contractile portion of the uterus becomes shorter and thicker. The vessels, which are intimately interwoven with the muscular bundles, are thus securely ligated.

The peritoneal covering of the uterus accommodates itself to the diminished volume of the organ by reason of its elasticity. The uterine peritoneum presents no loose folds, as a rule, even after complete retraction.

Situation of the Uterus. On examination over the abdomen at the close of labor, the fundus is felt about half-way from pubes to umbilicus; normally it becomes as hard as a billiard ball during after-pains, relaxing only partially in the intervals.

Lower Uterine Segment. The lower uterine segment and the cervix remain passive for several hours after labor. The cervix presents a soft and almost shapeless mass scarcely distinguishable by the touch from the loose vaginal folds. Within a few hours the tonicity of its muscular structures begins to be re-established and the cervix to resume its usual shape.

CHAPTER IX.

THE MANAGEMENT OF NORMAL LABOR.

PREPARATORY TREATMENT.

No more important duties devolve upon the obstetrician than those pertaining to the observation and care of his patient in preparation for labor. Until recent years this part of his responsibility was too often overlooked. Happily, to-day the necessity for prophylaxis against the possible ills and accidents of childbed is generally recognized. The enforcement of hygienic rules, the regulation of the health and habits of the patient during pregnancy, is vital to the successful conduct of the obstetric case. Even minor departures from the normal course of gestation should receive the attention of the physician and, as far as possible, be corrected. Especially ought he to inform himself in advance of the relative size of head and pelvis, of the presentation and position of the child, and, if possible, of all the facts of the individual case which may bear upon the issue of the labor.

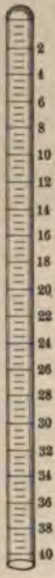
Urinary Examinations. The excretory activity of the kidneys should be watched from the first. It is a good general rule to examine the urine at least once monthly during the first six months, and twice or more during the seventh. In the last two months of gestation systematic examinations should be made weekly. The patient may be requested to report to her physician from time to time the daily quantity of urine. Toxic conditions can seldom occur in a patient who is voiding sixty ounces or more daily. The physician should not trust to a mere test for albumin. Albuminuria is not necessarily attended with marked toxæmia, nor is grave toxæmia in pregnant women always associated with albuminuria. Most essential are systematic quantitative determinations of the urinary solids. Especially significant is the daily excretion of urea. Though this particular solid is not a prominent factor in the toxæmia of pregnancy, the quantity of urea affords a fairly reliable index of the eliminative activity of the kidneys. It should not be forgotten, however, that the amount of urea and of the total urinary solids will vary with the character and quantity of food ingested and from other causes. The general condition of the patient should be taken into account as well as the urinary findings.

Tests for Albumin. For clinical use a good test for albumin is Esbach's. The reagent consists of picric acid, 10 grammes; citric acid, 20 grammes; water, 1000 grammes. The urine is mixed in a test-tube with an equal volume of the test solution. Heat and nitric acid, nitric acid cold by the contact method, or Tanret's test, with suitable precautions, are convenient and reliable tests for albumin.

Urinary Solids. One of the ready methods of computing the daily quantity of urinary solids is that of Haines, which is as follows: Multiply the last two figures in the number representing the specific gravity by the number of ounces of urine voided in twenty-four hours, and the resulting product by $1\frac{1}{10}$. This gives approximately the number of grains of solid matter in the given volume of urine. The average amount of solids in health, it will be remembered, is 1000 grains.

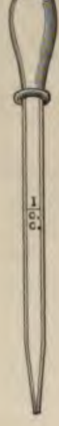
Urea. For the estimation of urea the following method from Bartley's *Chemistry* is recommended: "A graduated tube (Fig. 189) is filled to the fifth division with a 20 per cent. aqueous solution of potassic bromide. Chlorinated soda solution (Squibb) is then added to the fifteenth or twentieth division. Pure water to the depth of one inch is now floated upon the contents of the tube. It is most easily deposited there with the aid of a pipette. (Fig. 190.) One c.c. of urine is then floated upon the water, taking care that the liquids do not mix. The open end of the tube is now quickly closed securely by pressing the thumb firmly upon it. The contents are mixed by gently shaking. When the effervescence has ceased, the reading is taken at the top of the liquid column, while the tube is held inverted. The end of the tube, still closed by the thumb, is now submerged in a large jar of water. The thumb is then removed, and the tube raised or lowered, till the surface of the liquid in the tube is at the same level with that in the jar, and the reading is again taken. The difference between the two readings indicates the number of grains of urea in a fluidounce of the urine. This number multiplied by the number of fluidounces of urine voided in twenty-four hours gives in grains the total quantity of urea excreted during the day. The average daily amount is about 500 grains, but is liable to considerable variation within normal limits. The subject will be treated more fully under eclampsia.

FIG. 189.



Graduated tube.

FIG. 190.



Pipette.

(BARTLEY.)

The Nipples. Inquiry should be made with reference to the condition of the nipples. If they are small, depressed, or misshapen the patient should be directed to draw them out daily with the thumb and fingers. The manipulation not only helps to develop the nipples, but it renders them less liable to injury by the child's mouth in nursing.

Inversion and other deformities of the nipples are often the result of pressure from tight clothing; for this the remedy is obvious.

The sebaceous secretion which accumulates upon the nipples affords a nidus for the growth of micro-organisms, and uncleanliness is doubtless a prominent factor in infection of the nipples and resulting mastitis during lactation. Special attention should be paid to the cleanliness of these parts during the later months of pregnancy. A borax solution, one tablespoonful to the pint of water, is a good detergent. Bathing with this once daily is useful as a prophylactic against the occurrence of sore nipples during the nursing period.

The following method has been recommended for the prevention of fissured nipples during lactation; every night in the last two months of pregnancy the patient anoints the nipples with lanolin, kneading them with the thumb and fingers. The hands must first have been cleansed carefully with soap and hot water. In the morning the nipples are cleansed by prolonged brushing with a soft brush and pure soap and water.

ANTEPARTAL EXAMINATION.

It is the duty of the obstetrician to inform himself before labor of the presentation and position of the child, the relative size of head and pelvis, and, as far as possible, of all the obstetric facts which may bear upon the result of the labor. This is usually done at about the end of the eighth month. The antepartum examination is conducted according to the following scheme:

A. Abdominal Examination.

DIAGNOSIS OF PRESENTATION AND POSITION OF FŒTUS.

Preparation. The patient lies in the horizontal position on a hard bed or table, the examiner standing or sitting at either side. The bladder and the rectum must be empty. The abdomen may be fully exposed or be covered with a thin sheet. If the sheet is used the examination is conducted through it or with the hands on the abdomen beneath it. The examiner first bathes his hands in warm water. This renders the tactile sense more acute and tends to prevent reflex contractions of the abdominal and uterine muscles which would be excited by contact of cold hands.

Location of Child's Back and the Small Parts. Three methods are available. One or all may be employed.

1. The child's back and the limbs or small parts usually may be made out by palpating systematically the entire surface of the abdominal tumor. Only the volar surfaces of the finger-tips are applied, and the touch should be light. The tactile sense is keenest with but moderate pressure. Deeper pressure is only occasionally necessary to make out the degree of resistance, the hardness, and the mobility of the fœtal parts beneath the fingers.

The small parts are felt as small nodules, knees, ankles, elbows, etc., which glide about freely under the touch. They are identified by circling motions of the fingers with moderate pressure. Sometimes a fœtal extremity may be mapped out through the greater part of its length.

2. The fœtal dorsum is more readily palpated if the trunk is steadied by pressure in line with the long axis of the fœtus, the hand being held over the upper fœtal pole. This increases the convexity of the dorsal plane and brings it nearer to the examining hand.

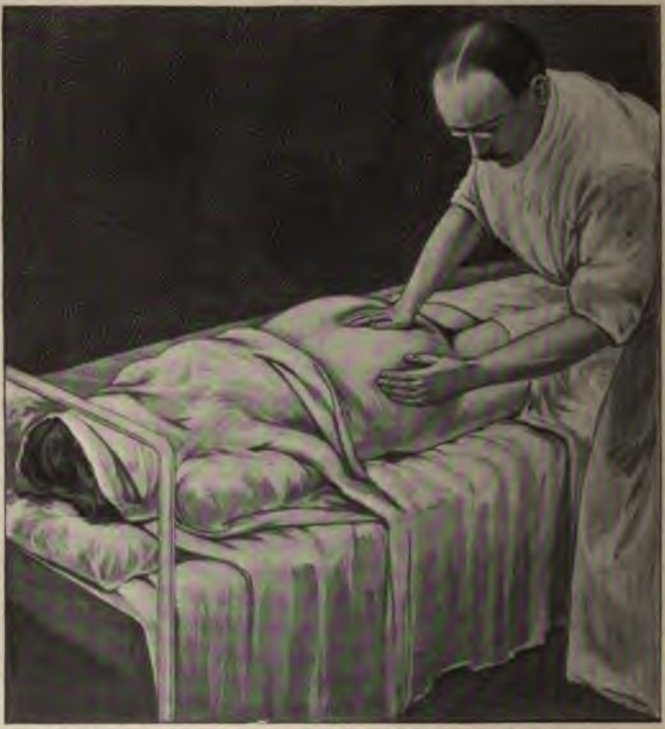
3. Applying one hand flat on the middle section of the abdomen, moderately deep pressure displaces the fœtus to the side toward which its back lies and the liquor amnii to the opposite side. Still maintaining the pressure, the hard body of the fœtus may be felt on one side of the abdomen and only fluid on the other side. (Fig. 191.)

By these simple manipulations it is usually possible to determine to which side of the mother the child's back lies.

To learn whether the back of the child is turned toward the back front of the mother it will be necessary to distinguish the dorsal fro the lateral plane of the fœtus. The back offers a broad resisting surfa which is somewhat convex from end to end, and which runs off smooth upon the head. The lateral plane of the fœtus is narrower; it is n convex from end to end, and a sulcus is felt between it and the head.

Except in twins, where legs and arms can usually be felt in vario directions, finding the small parts in one section of the abdomen confirm the location of the dorsum in the opposite region. Small parts to t right indicate a left, small parts to the left indicate a right position the fœtus. Small parts few and hard to find suggest an anterior positi

FIG. 191.



Displacing fœtus to one side of abdomen for locating dorsal plane.

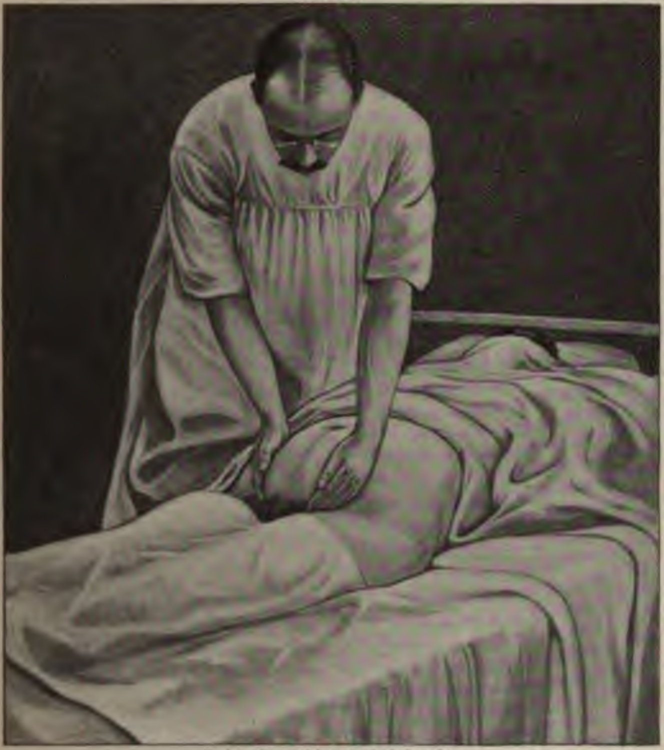
of the child; small parts numerous and found near the middle sectio the abdomen usually point to a dorso-posterior position of the fœ If small parts can be felt beyond either end of the fœtal ellipsoid, end is pretty surely the breech.

The examination, thus far, as a rule, presents little difficulty. W the abdominal wall is over-fat or rigid, the uterus contracted, or t from distention, as in hydramnios and certain other conditions, the f parts are often more or less obscured.

Palpation of the Lower Fœtal Pole. The hands are placed over lateral aspects of the lower abdomen with their palmar surfaces ne g each other, the finger-tips toward the mother's feet. The ends of fingers should rest at first a little above Poupart's ligament. The ls are pressed downward toward the excavation, and backward ard the mother's back, till the lower fœtal pole is caught between n. (Fig. 192.) If not readily found the object may sometimes be ed by moving the hands sharply from side to side, as if to toss the l pole from one hand to the other, the hands meantime being brought er and nearer together.

he first object now is to find whether the fœtal pole under examina- is the head or the breech. The two poles are distinguished by the wing characteristics: The head is hard and globular, and it presents

FIG. 192.



Palpation of lower fœtal pole.

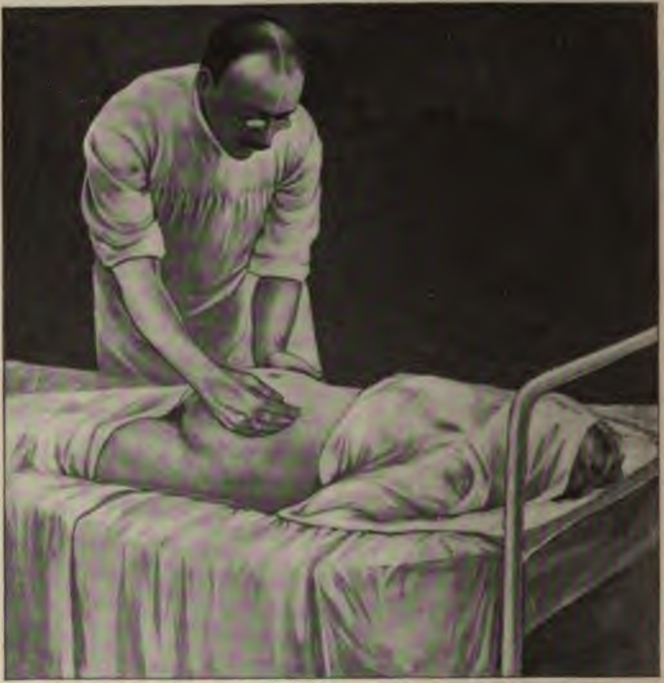
cus laterally between itself and the trunk. Again, the head is the fœtal part that sinks into the pelvic excavation before labor. In igravidæ, as a rule, the head when it presents is found in the lesser s during the last one or two months of pregnancy; in multigravidæ, g to greater laxity of the abdominal walls, it lies above it till the d of lightening, and in two-thirds of the cases till labor begins. n, therefore, the presenting pole of the fœtus is found in the excava- before labor, that pole is the head. The breech is alone smaller, the extremities larger, than the head. It lacks the hardness and the

globular shape of the head ; it presents no sulcus, and in all cases it
above the excavation till labor is established.

The presence of the lower fœtal pole in one iliac fossa means a tr
verse presentation.

Palpation of the Upper Fœtal Pole. The hands are placed on the al
men over the upper portion of the uterus with the finger-tips toward
mother's head, the volar surfaces of the hands nearly facing each ot
(Fig. 193.) The upper fœtal pole is now palpated for the distinguis
marks of the head or the breech. The poles are distinguished by
characters already given and by the fact that the head when in the u
uterine segment is susceptible of ballottement. The head can be to
from side to side between the hands, or be made to bob under the fin

FIG. 193.



Palpation of upper fœtal pole.

by light intermittent thrusts through the abdominal wall with
hand.

The breech lacks the flexible attachment to the trunk which mark
head, and it has little mobility not only because of this, but als
reason of the greater bulk of the component elements of the pelvi
of the fœtal ovoid.

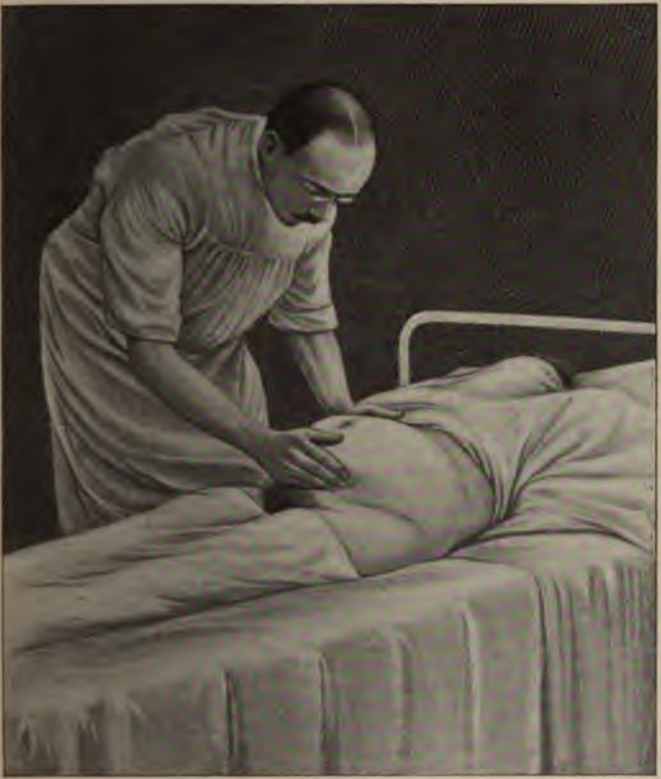
Location of the Anterior Shoulder. The hands are held firmly upo
abdomen over the sides of the fœtal head and without relaxing the p
are moved toward the trunk. The first obstacle encountered is
anterior shoulder. It is more surely identified by palpating it wit
hand while the other steadies the fœtus by downward pressure

the breech in the direction of the fœtal axis. (Fig. 194.) It presents a small rounded prominence immovably attached to the trunk. Sometimes its anatomical elements can be traced.

Finding the anterior shoulder on the left of the median line of the abdomen in vertex presentation indicates a left, on the right a right position of the fœtus. Anterior shoulder within one or two inches of the median line indicates an anterior, several inches from the median line a posterior fœtal position.

Location of the Cephalic Prominence. When the head lies in the excavation in vertex presentation the occipital pole, owing to head flexion, sinks more deeply in the cavity than the sinciput. The latter lies at or just above the brim; therefore, the greatest cephalic prominence at the brim corresponds to the sinciput. It is located by laying the hand across the lower abdomen just above the symphysis and grasping the head (Figs. 195 and 196). The situation of the greater prominence may also be made out by palpation with both hands, as shown in Fig. 197. The hand on the side on which the occiput lies sinks more deeply into the excavation than the other. The prominence of the sinciput is naturally most marked in occipito-posterior positions.

FIG. 194.

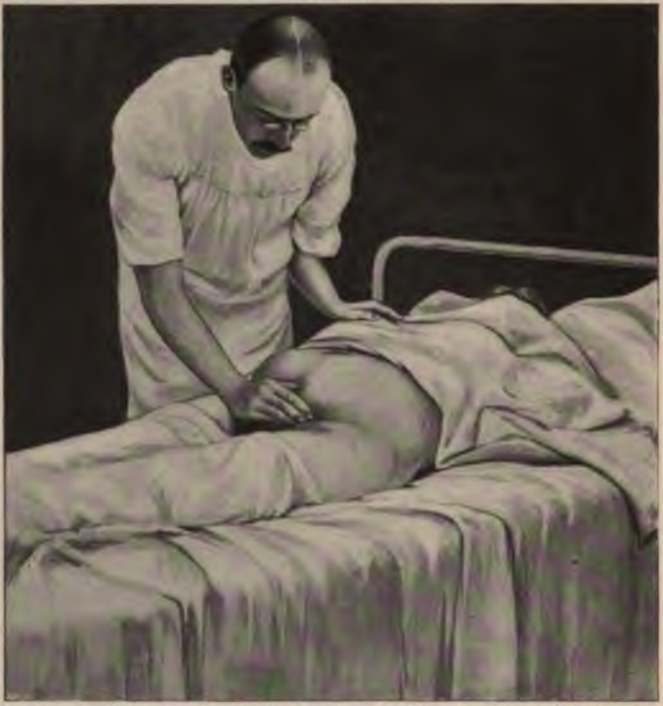


Locating anterior shoulder.

Location of the Fœtal Heart. Auscultation may be practised with or without the stethoscope. The room must be still. For immediate auscultation, without the stethoscope, the abdomen is covered with a thin sheet or towel. Since a continuous solid medium helps conduction, the abdominal wall should be pressed firmly against the uterus. Downward pressure of the breech in the direction of the long axis of the fœtus facilitates the examination by thrusting the dorsum forward. The focus of auscultation, the point at which the heart-tones can be heard loudest, as a rule, nearly overlies the lower angle of the left fœtal scapula.

Fœtal heart on the left of the median line indicates a left, on the right, a right position of the fœtus. Fœtal heart near the median line points to an anterior, far away from it, to a posterior fœtal position. When the fœtal heart is above the umbilicus the presentation is generally a breech, when below it, a vertex presentation. The location of the heart-tones, however, cannot be wholly relied on for the diagnosis of presentation. The heart lies nearly midway between the two extremities of the fœtal ellipsoid. Its height in the abdomen is, therefore, not materially affected by the presentation in multigravidæ in whom neither fœtal pole sinks into the excavation before labor. In primigravidæ, in whom the fœtus rests lower in vertex than in breech presentation, the location of the fœtal heart is of some value for the diagnosis of presentation.

FIG. 195.



Locating cephalic prominence by grasping fœtal head with hand held across the suprapubic region.

Sometimes it happens that the focus of auscultation does not immedioverlie the heart. It may be found at some remote point in con-

FIG. 196.

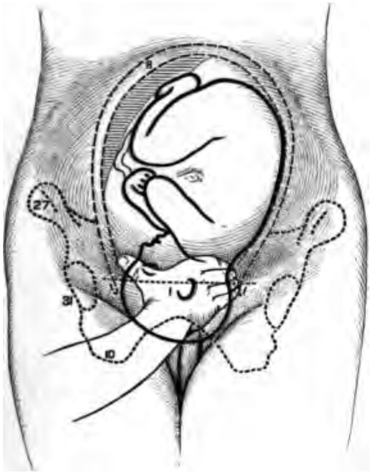


Diagram showing relation of hand to fœtal head in manipulation for locating cephalic prominence.

uence of firmer contact of the fœtus with the uterine wall at that nt. For a like reason a second focus may in rare instances be found.

FIG. 197.

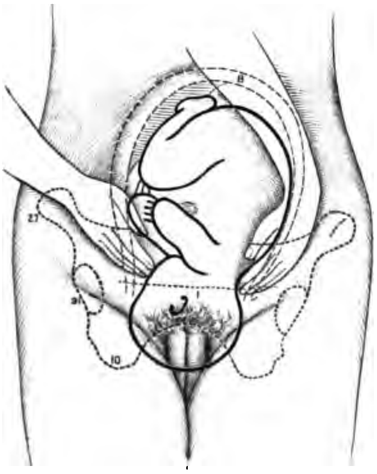


Diagram showing method of locating cephalic prominence by palpation with both hands.

dorso-posterior positions, in hydramnios, and in certain other con-
ns the heart-sounds are not always audible.

nclusions. A complete abdominal examination usually affords more reliable data for determining the fœtal presentation and position than does the internal examination. With rare exceptions a definite and positive diagnosis is easily reached. The examiner should accustom himself to reserve his decision till the facts are all in hand, basing his conclusion upon the sum total of the findings.

ABNORMAL CONDITIONS.

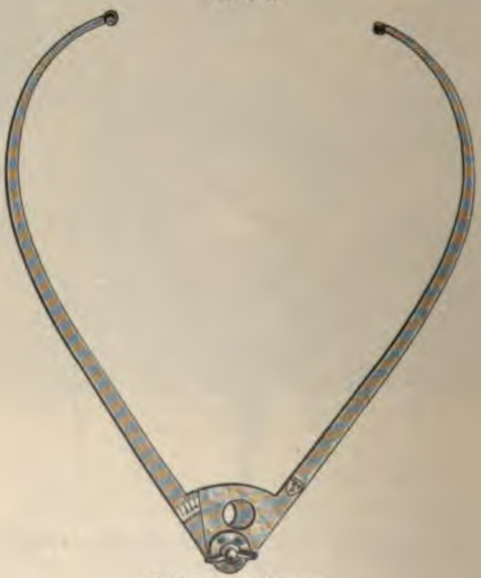
In course of the abdominal examination pathological conditions of maternal or fœtal origin that may complicate the labor are to be looked for. Morbid growths in the abdomen or pelvis may be detected by palpation. The presence of hydramnios or of pendulous abdomen is noted. Excessive size and persistent tension of the uterine tumor should suggest twins. A definite diagnosis is usually possible. Hydrocephalus ought to be recognized by palpation. It is more surely made out by measurements taken through the abdominal wall with calipers.

The location of the placenta when implanted anteriorly can sometimes be determined in the external examination. The convex margin can occasionally be felt as a resisting ring; within the placental area the fœtal parts are obscure to the touch, while elsewhere they are easily detected. Thus the diagnosis of placenta prævia is sometimes possible by external palpation.

EXTERNAL PELVIMETRY.

In connection with the abdominal examination external measurements of the pelvis are to be taken, except in cases in which there is ample assurance from the character of previous labors that the pelvis is normal. Extreme contraction or marked asymmetry is readily recognized by

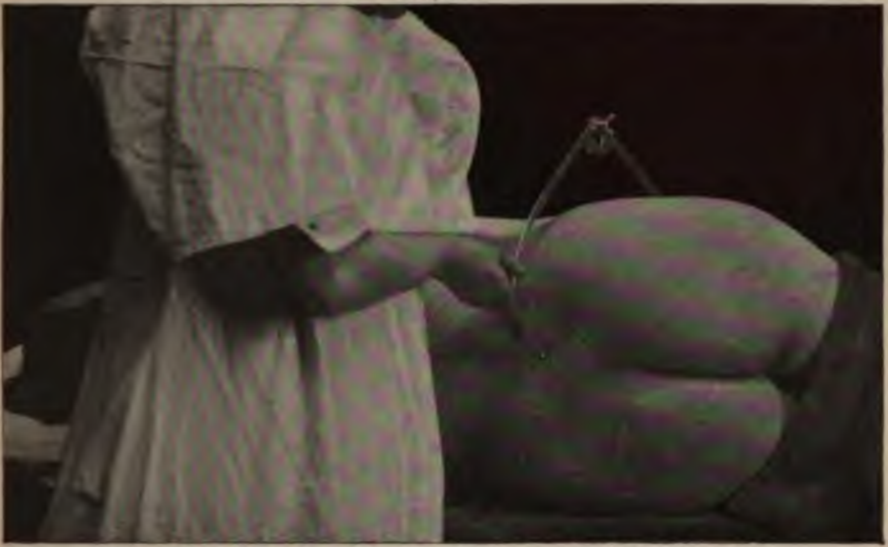
FIG. 198.



Collyer's pelvimeter.

palpation. Slight deformities are detected only by systematic measurement. For this purpose a suitable pelvimeter will be required. (Fig. 198.) Most essential are the antero-posterior diameter of the pelvis or the external conjugate, the interspinal, the intercristal, and the external oblique diameters. Of these the diameter of greatest practical value is the external conjugate.

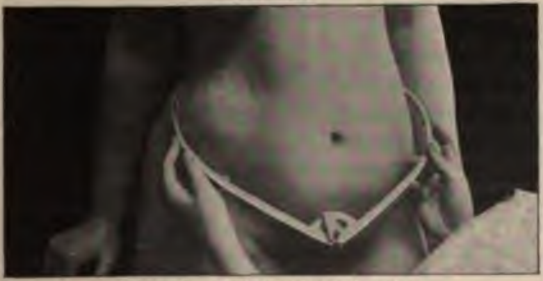
FIG. 199.



Measuring the external conjugate. The dimples corresponding to the posterior superior spines of the ilium are shown in the figure.

The external conjugate is measured from the fossa just below the spine of the last lumbar vertebra to a point on the pubic surface just below the top of the symphysis. (Fig. 199.) To locate the last lumbar spine draw an imaginary line between the dimples corresponding to the posterior superior iliac spines. The second vertebral spine above this line is the last lumbar. The external conjugate diameter, or, as it is sometimes called, the diameter of Baudelocque, is nearly parallel with the plane of the brim and with the internal conjugate.

FIG. 200.



Measuring the intercristal diameter.

The method of measuring the intercristal diameter (Fig. 200) and the interspinal diameter is obvious. (See p. 170.)

The external measurements are fairly reliable as evidence of the shape and capacity of the pelvis internally. When all are small the pelvis is generally contracted. If the interspinal is equal to or greater than the intercristal diameter the pelvis is flattened. Inequality in the external oblique diameters is evidence of asymmetry.

To find the true conjugate from the diameter of Baudelocque, from 7 to 12.5 cm., 2¾ to 5 inches, must be deducted from the latter, according to the estimated thickness of the bones and the soft parts, the inclination of the symphysis, and the height of the sacral promontory.

Since it is impossible to know the exact allowance to be made in a given case, the external conjugate cannot be wholly relied on for detecting pelvic contraction. Yet it may safely be assumed that the pelvis is flattened when the diameter of Baudelocque falls below 16 cm., 6¼ inches, or that it is ample when the external conjugate exceeds 21 cm., 8¼ inches. As a general rule, contraction should be suspected when the external conjugate is less than 18 cm., 7 inches; the true conjugate is probably, though by no means surely, ample when the external conjugate is above 18 cm.

B. Vaginal Examination.

An internal exploration is advisable in all cases as a part of the preliminary examination; in women pregnant for the first time and in others whose obstetric history leads to suspicion of pelvic deformity, it is imperative. The objects are to learn the condition of the soft parts—vulva, vagina, cervix, especially in multigravidæ—to confirm the diagnosis of presentation, to detect a possible vicious insertion of the placenta, and to determine the capacity of the bony pelvis.

Antiseptic Preparation. The external genitals of the patient and the hands of the examiner should be prepared with the same care as for internal examinations during labor. For the technique of disinfection the reader is referred to page 228.

Examination of the Soft Parts. In multigravidæ the vulva, the vagina, and the cervix are first examined for injuries resulting from previous deliveries. In all cases it should be noted whether pathological growths or congenital defects of the soft parts, which may complicate the labor, are present. A cephalic presentation, as a rule, may readily be made out, even before dilatation of the cervix, by the touch through the uterine wall. A low implantation of the placenta in advance of the head should readily be detected.

Internal Pelvimetry. Most important is the examination of the bony pelvis. This should include the pelvic inclination, the configuration of the pelvis, the depth and inclination of the symphysis pubis, the shape of the sacrum, the height of the promontory, and the relative size of the head and pelvis. The pelvic diameters, especially at the inlet and the outlet, should be definitely determined.

For internal pelvimetry the hand, as a rule, is the best instrument. The shape of the sacrum and the general capacity of the pelvis can be estimated approximately by palpation.

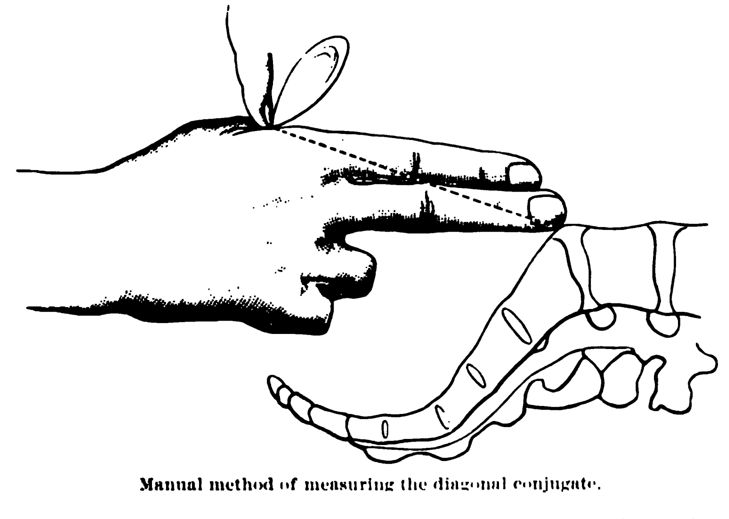
The Pubo-coccygeal Diameter is measured by placing the end of the second finger against the tip of the coccyx and bringing the radial edge of the outstretched hand in contact with the subpubic ligament. The point at which the latter rests against the hand is then marked by a finger of the other hand. On withdrawing the hand the distance between the two points of contact is measured with tape or calipers.

The Sacropubic Diameter is measured in like manner.

The Transverse Diameter at the outlet is best measured externally. With the patient in the lithotomy position the examiner places the thumbs upon the skin over the ischial tuberosities. The palmar surfaces of the thumbs are pressed firmly against the inner aspects of the tuberosities at the level of a line running through the anterior margin of the anus. The distance between the two points of contact is then measured by an assistant. Under an anæsthetic during labor this diameter may be estimated also by introducing the extended hand partly within the vaginal orifice between the tuberosities, and comparing the bisischial space with the width of the hand near the finger-tips.

The Diagonal Conjugate is measured as follows: With the patient in the lithotomy position two fingers of one hand are passed into the vagina. If the head is found resting deeply in the lesser pelvis in the ninth month of pregnancy the relative capacity of the brim is assured and the measurement is unnecessary. Should only the occipital pole have sunk into the excavation it may be pushed up. The finger-tips are carried up and down over the region of the sacral promontory till the most prominent point is found. Against this the ulnar margin of the second finger-tip is held firmly. The radial edge of the hand is then raised till it rests against the subpubic ligament. The latter point of contact is marked by a finger-nail of the other hand. (Fig. 201.) On withdrawing the hand the distance between the two points of contact measured as in the case of the pubo-coccygeal diameter.

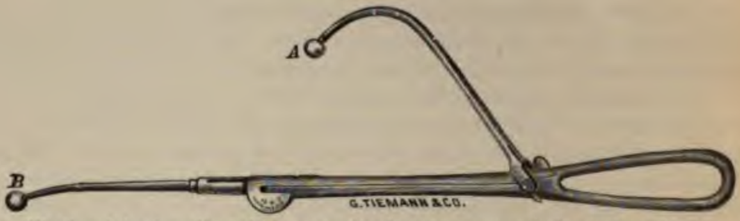
Fig. 201.



Manual method of measuring the diagonal conjugate.

The True Conjugate is computed from the diagonal, since the former cannot be measured directly. The diagonal conjugate corresponds nearly to the hypothenuse of a triangle of which the base is the true conjugate. Generally the latter is obtained by subtracting from a half to three-fourths of an inch from the diagonal conjugate. The amount to be deducted, however, will vary with the depth and the thickness of the symphysis pubis, with its inclination, and with the height of the sacral promontory.

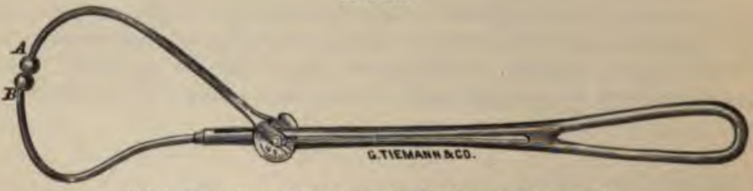
FIG. 202.



Hirst's pelvimeter adjusted for measuring from promontory to front of symphysis.

As these elements in the question are variable and their value in the individual case cannot be determined with accuracy, the estimation of the true conjugate by the foregoing plan is only approximate. A possible error of at least a quarter of an inch must be assumed in all cases; frequently it is greater.

FIG. 203.



Pelvimeter adjusted for measuring thickness of symphysis.

For more exact determination of the true conjugate Hirst, with an instrument of his own device, measures the distance from the promontory to the anterior aspect of the symphysis two-fifths of an inch below its upper margin. The thickness of the pubic joint is then measured with the same instrument, and the difference between the two measures gives the precise value of the true conjugate.

CASE RECORDS.

The habit of keeping systematic records conduces to thoroughness in the management of cases. It would be well if physicians in private practice, as in hospital work, made use of blanks for obstetric histories.

The following is a simple form for obstetric records which may be modified to suit the requirements of individual practitioners:

OBSTETRIC RECORD.

CASE of APPLICATION No.
Date of application 19

HISTORY.

Residence Nationality Married Single Widow
para Character of previous labors Puerperiums
Miscarriages
Last menses, date duration quantity
Quickening, date

ANTE-PARTUM EXAMINATION.

Date 19
General health
Heart
Lungs

Urine
- Amount
- Reaction
- Specific gravity
- Albumin
- Sugar
- Total solids
- Urea
- Casts
- Other microscopic findings

Breasts
- Size
- Veins
- Areolæ
- Nipples
- Papillæ

ABDOMINAL EXAMINATION.

Dorsum of fœtus, to mother's front back, right left
Fœtal head, where found size Fœtal movements
Anterior shoulder, where found

Fœtal heart
- Rate
- Rhythm
- Force
- Location

Height of fundus above symphysis
Liquor amnii, scanty normal excessive
Fœtus, one two Length of fœtal ovoid
External conjugate Interspinal diameter Intercristal diameter Obliques
Location of placenta Complicating tumors

VAGINAL EXAMINATION.

Condition of vulva, old injuries œdema rigidity

Vagina
- Mucous membrane, healthy or not
- Secretion, healthy or not
- Other abnormalities

Cervix
- Position
- Size
- Softening
- Old injuries

Diagonal conjugate True conjugate Other diameters

LABOR.

Date 189
Stage of Dilatation. Pains began frequency character
General condition of patient Temperature Pulse
Bladder, full or empty Rectum, full or empty Membranes ruptured or not
Presentation Position Posture

Fœtal heart
- Rate
- Rhythm
- Force
- Location

Number of vaginal examinations
Complications and medication Duration

Stage of Expulsion. Pulse Temperature Character of pains

Fœtal heart { Rate, Rhythm, Force, Location } Vaginal secretion, free or scanty

Membranes ruptured, when how

Perineal stage, duration management

Number of vaginal examinations

Complications, medication, operations

Duration

Placental Stage.

Placenta, delivered at method

size shape seat anomalies

Membranes, complete or not how removed

Umbilical cord, insertion length anomalies

Uterus, degrees of retraction height of fundus shape

Injuries Medication

General condition of patient Pulse Temperature

Child, male female, alive dead, length weight

	OM	OF	SOB	BIP	BIT
Head { Diameters					
Head { Circumferences					

Injuries

Congenital anomalies Rectum and urethra, pervious or not

Temperature in rectum shortly after birth

TEMPERATURE AND PULSE

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Date														
Temp.														
C. F.														
41.1° 106°														
40.6 105														
40.0 104														
39.4 103														
38.9 102														
38.3 101														
87.7 100														
37.2 99														
36.7 98														
Pulse														
180														
170														
160														
150														
140														
130														
120														
110														
100														
90														
80														
70														
60														
50														
40														

MOTHER.

Diet
Bowels
Uterus
Treatment

Breasts
Bladder
Lochia

CHILD.

General condition Temperature
Eyes
Digestive organs { Mouth, Stomach, Bowels
Bladder Umbilical wound
Weekly gain in weight

CONDITION ON DISMISSAL.

Date 19

General condition of mother
Uterus, size position shape
Cervix, size shape position injuries
Vulva and vagina, injuries
Child

Obstetric Armamentarium. Such instruments and drugs as are likely to be needed in the conduct of ordinary labor and in the more important emergencies of the lying-in room should be carried in the obstetric bag. The usual outfit comprises: a pelvimeter, an obstetric forceps, a hypodermic syringe, a gravity or a Davidson syringe, a glass douche tube, a soft rubber catheter, a soft-rubber tube with bulb attached for clearing the child's pharynx in case of partial asphyxia, a hollow needle for hypodermoclysis, a Sims speculum, a double tenaculum, a straight uterine dressing forceps, a curette about 14 inches in length, needle forceps; needles moderately curved and of assorted sizes from 4 to 7 cm., or 1½ to 2½ inches, in length, for suturing lacerations; scissors, aseptic sutures of catgut and of silk and of silkworm-gut in hermetically sealed bottles or glass tubes, a straight, blunt-pointed bistoury for episiotomy, two hand-brushes, a set of dilating water-bags, and a sealed package of 2 per cent. sterilized gauze, enough to fill the post-partum uterus.

The drugs most frequently needed are: chloroform, ether, ergot, digitalis, veratrum viride, trinitrin, morphine, chloral, and mercuric chloride or iodide. All except the anæsthetics may be had in tablet form.

A useful apparatus in forceps delivery in the absence of competent assistance is Buckmaster's or Robb's leg-holder for holding the thighs flexed on the abdomen. It is about three inches wide and two yards long, and is made of duck. At one end is a loop, which is slipped over one leg just below the knee. The band is carried over one shoulder, across the back, under the other shoulder, and fastened below the other knee. The band is so adjusted that it pulls from the outer side of the leg loop, abducting the knees. If made of thin material, the apparatus occupies but little room in the obstetric bag.

Obstetric Antisepsis.

To an obstetrician, Ignatius P. Semmelweis, belongs the credit of first putting into practice the principles of the present antiseptic system. In 1847, while an assistant in the Lying-in Department of the Vienna General Hospital, he was deeply impressed by the high mortality that prevailed in the service. This mortality he soon found was greatest in the students' clinic. Nearly 10 per cent. of the women delivered in that branch of the service died. The students were engaged in the work of the dissecting-room and the dead-house at the same time that they were pursuing the course in practical obstetrics. In the midwives' clinic, on the other hand, the mortality seldom exceeded 3 per cent. Prolonged labor in the students' clinic was almost uniformly followed by death; while in the midwives' clinic the length of the labor made little difference in the death-rate. Semmelweis had also observed that women delivered before admission and unattended wholly escaped the fatal fever. While pursuing these observations one of his associates, Professor Kolletschka, died from a dissection wound. The similarity of his colleague's symptoms to those presented by the puerperal women dying of fever was apparent. It immediately dawned upon Semmelweis that the cause of the fatal malady in the lying-in service was the same as that which had resulted in the death of his colleague. Acting on this belief, he required the students to wash their hands in chlorine water before making internal examinations, and he restricted the number of such examinations. The death-rate immediately fell, and in little more than a year it had been reduced to less than 2 per cent. Thus was established the first step toward one of the most important of modern surgical discoveries.

Antiseptic Agents.

Mechanical Cleansing. Not the least important part of the antiseptic technique is the mechanical cleansing. This removes the greater part of the offending material. A well-polished instrument may be rendered almost sterile to culture tests by prolonged brushing with soap and hot water, and finally washing well with sterilized water. For the operation-field and for the hands and arms of the operator this part of the process is doubly necessary, since the removal of surface epithelium and sebaceous matter not only carries with it the major portion of the infectious material, but it is essential to the action of the chemical antiseptics. Freed from fatty matter and well wet by the soap-and-water scrubbing, the skin readily absorbs the antiseptic solution.

Heat is at once the most generally available and the most reliable germicide; either dry or moist heat may be used. Moist heat is much the more effective.

Dry Heat. Exposure for three hours to a temperature of 140° C. (284° F.) kills all pathogenic organisms and their spores. A special apparatus may be employed or the oven of a cooking-range can be utilized. A thermometer capable of registering 148° C. (300° F.) or more must be used for regulating the temperature. Dressings, however, are penetrated by hot air only very slowly, and the method is, therefore, inadvisable for such material. It may serve for such utensils as are capable of withstanding prolonged baking without injury, but the length of time required renders it unsuitable for general use.

Moist Heat is employed in the form of steam and of boiling water.

Steam is effectual at a temperature of 100° C. (212° F.) when in motion. Superheated steam partakes of the disadvantages of hot air, and moist steam acts to the best advantage only as flowing steam. Exposure for thirty minutes to flowing steam at 100° C. is almost absolutely reliable. In institutions steam sterilizing is now generally practised under a pressure of fifteen pounds, temperature 121° C., 250° F., or more, by means of an autoclave. Special provision is made to secure penetration.

Numerous forms of steam sterilizers are to be had. A cheap and convenient apparatus for the purpose is the Arnold steam sterilizer, or one of its modifications.

Boiling for five minutes in water kills all pathogenic organisms likely to be encountered and their spores. One of the most effective of all practicable methods of using heat is boiling for five or ten minutes in a 1 per cent. solution of sodium carbonate or bicarbonate. Articles so treated are sterilized in less time than in boiling water. Even the most resistant spores are destroyed in less than five minutes. The addition of the soda has the further advantage that it protects metallic instruments from tarnishing, and it removes fatty matter. For instruments it is desirable that the soda be chemically pure, since the impurities in the commercial article may cause corrosion. A fish-boiler or a wash-boiler may be utilized in the absence of a special sterilizing apparatus. Boiling in the soda solution is the method now generally employed for sterilizing instruments. For convenience in handling, instruments are best deposited in a wire basket or in a folded towel during the boiling. Steam sterilizing is especially applicable for dressings and utensils.

Chemical Antisepsis. Among the most useful chemical germicides may be mentioned the mercuric chloride or iodide and carbolic acid. Creolin, lysol, and a multitude of other antiseptics more or less extensively used by obstetricians offer little or no special advantage. Chlorinated soda solution, peroxide of hydrogen, 3 per cent. solution, and iodine water have the merit of being non-toxic.

Mercuric chloride is decomposed in the presence of alkalies or of albumin. In contact with the former the mercury is precipitated in the form of an oxide, and in the presence of the latter an albuminate of mercury is formed. A plain sublimate solution, therefore, soon becomes inert if mixed with bloody fluids. To prevent these changes, solutions of the bichloride of mercury for antiseptic use are acidulated with five parts of tartaric, acetic, or hydrochloric acid to one of the mercurial. The biniodide of mercury, on the other hand, yields a precipitate with albumin in acid, but not in neutral or alkaline solutions. The addition, however, of an equal weight of potassic iodide is required to render it freely soluble. These two mercuric salts are equally active as germicides, or nearly so, in solutions of equal strength. The strengths most commonly employed are from 1:5000 to 1:500.

The following formulas represent some of the antiseptic solutions used in obstetric practice:

Mercuric Chloride (Sublimate) Solution, 1 : 2000.

Bichloride of mercury	Gr. vijss.
Tartaric acid	Gr. xl.
Sterilized water	Oij.

Mercuric Iodide Solution, 1 : 2000.

Biniodide of mercury Potassic iodide } āā	Gr. vijss.
Sterilized water	Oij.

Chlorinated Soda Solution, 1 : 10.

Labarraque's solution	℥j.
Sterilized water	℥ix.

Creolin Solution, 1 : 100.

Creolin	ʒijss.
Sterilized water	Oij.

Carbolic Solution, 1 : 20.

Carbolic acid	℥j¼.
Glycerin	℥iij.
Sterilized water	Oij.

Convenience and accuracy in the employment of the mercurial antiseptics are promoted by the use of tablets containing the required chemical ingredients.

The *peroxide of hydrogen* solution may be used plain or diluted with two to four volumes of sterilized water; iodine-water 2 per cent. strength. The latter may be prepared by diluting tincture of iodine with water till it is of a port-wine color, adding enough potassic iodide to hold the iodine in solution.

Choice of Methods.

Since sterilization by exposure to the action of chemical solutions is uncertain and often imperfect, the latter should be reserved for purposes to which heat is not applicable. Their employment is limited almost wholly to skin disinfection.

Boiling, steaming, or even hot air may be used for utensils, or dressings which are not likely to be injured thereby.

At or just before the onset of labor the nurse should sterilize by steam a supply of towels, cheesecloths for sponging, the vulvar dressings, and the ligature for the umbilical cord. They are first enveloped in a towel which is pinned securely, and in this they are kept after sterilizing till they are wanted for use.

Obstetric forceps, needle forceps, needles, scissors, and such other instruments as may be required, are wrapped in like manner and boiled for five minutes in water or, better, in the soda solution.

The Obstetrician.

Of first importance is the asepsis of the hands. A hand-brush, soft soap, and a supply of the required chemical antiseptics are essential parts of the obstetrician's armamentarium. Soft soap may conveniently be carried in collapsible metal tubes. The chemical agents are carried in tablets or in the form of powders. The soap may be sterilized by heating to 100° C., and the hand-brushes by boiling in the soda solution. It is desirable that the hand-basin used for the soap and water cleansing, and those containing antiseptic solutions, be sterile.

Cleansing the Hands.

The hands and forearms are prepared by one of the following methods before contact with the genitals of the lying-in patient:

Furbringer Method—Modified.

(*a*) They are brushed systematically for ten minutes with soap and hot water and a hand-brush. The water is used as hot as can be borne. Special attention must be given to the finger-tips, the sides of the fingers, and the subungual spaces.

(*b*) The nails are then cleaned with a nail-cleaner and again brushed for five minutes. The instrument should not be sharp, but should rather have moderately blunt edges, which may leave the surface of the nails smooth and polished. A piece of soft wood sharpened to a blunt point is a good substitute for the usual toilet article. It is made aseptic by boiling or steaming before using. The nails should constantly be kept short with their cut edges smoothed and polished, and the corners rounded.

After the soap-and-water cleansing the soap is removed by rinsing the hands in sterile water.

(*c*) Finally, the hands and forearms are immersed for five minutes in a 1:2000 mercuric chloride solution.

It is a distinct gain to saturate the skin for a minute with alcohol before immersion in the antiseptic solution. The alcohol should be of about 75 per cent. strength. This acts in some degree as a solvent for sebaceous material that may have escaped the soap-and-water cleansing, and it dehydrates the outer layer of the skin, thus permitting the antiseptic to sink more deeply.

Permanganate Method.

Steps (*a*) and (*b*) are carried out as in the preceding method.

(*c*) The hands and forearms are then immersed for five minutes in a saturated solution of potassium permanganate in hot boiled water till of a deep mahogany-brown color.

(*d*) The hands and forearms are now held in a saturated solution of oxalic acid in sterile hot water till the brown stain is completely discharged.

(*e*) Lastly, they are immersed for three minutes in a 1 : 500 mercurial solution.

Chlorinated Soda Method.

Steps (*a*) and (*b*) are the same as before.

(*c*) The hands and forearms are then covered with a paste made by wetting chlorinated lime with water. They are next rubbed with a lump of crystallized sodic carbonate (washing-soda) till a sensation of cold is felt. This yields chlorinated soda in its nascent state, which is the active disinfectant. Friction is now applied with a hand-brush for five minutes.

(*d*) The chemical is washed off with sterilized water and the skin surface is rinsed with alcohol or with weak ammonia water.

(*e*) By the permanganate or the chlorinated soda process the hands usually may be rendered practically sterile. Yet absolute disinfection is impossible, especially after infection by virulent exposures.

Precautions.

After cleansing the hands care must constantly be observed to prevent reinfecting them. Contact of the hands with any object that is not aseptic must be scrupulously avoided. Frequent rinsing with the antiseptic solution is essential during attendance on the labor, since germs are constantly coming to the surface from the sweat-glands and hair-follicles where they had escaped the primary disinfection. Keeping the hands wet with glycerin containing a grain to the ounce of one of the usual mercurial salts favors continuous disinfection and helps to keep the skin soft. The glycerin should have been sterilized by heat.

Operating Suit. During actual attendance on the patient the obstetrician wears a freshly sterilized operating gown, or he may prefer a coat and trousers of white duck or linen, to be worn over his usual clothing.

Lubricants. For digital examinations within the passages no lubricant is required, as a rule. It is generally sufficient that the fingers be wet with the antiseptic solution. Should any other lubrication be required, as, for example, when the hand is to be introduced within the vagina, the back of the hand may be smeared with glycerin or with vaseline which has been heated for ten minutes to 100° C.

Boiled Gloves. Should the physician be called upon to attend a labor directly after septic contact or when scant time is allowed for rigorous disinfection, he may wear rubber gloves which have been sterilized by boiling in water or in a solution of common salt. The soda solution is unsuitable, since it rapidly destroys the rubber. Lacking these, such manipulations as are required during the perineal stage of natural labor may safely be conducted through the intervention of an aseptic towel. In a considerable proportion of cases it is possible to manage the labor, if need be, without direct contact of the hands with the field of the obstetric wounds. The experiences of Kelly and of Zweifel have shown that no method of skin sterilizing can fully be trusted directly after exposure to an acute infectious process.

There is no kind of surgical work in which the routine use of rubber gloves finds a more appropriate application than in obstetrics. It is the writer's practice to wear them in practically all cases during attendance on labors. Since the gloves may be punctured or torn in use, the disinfection of the hands should be carried out as carefully as when gloves are not to be worn.

The Nurse.

It is scarcely necessary to say that the nurse must be no less careful in all particulars than the doctor is required to be in the observance of antiseptic details. Her clothing must be scrupulously clean, and she should wear wash-dresses. As an extra precaution she must refrain from attendance on obstetric patients for a week or more after a septic exposure. During that time her hands and forearms are to be sterilized repeatedly, and she should take two or three full baths, with special pains to cleanse the hair. In all cases the nurse makes an entire change of clothing on taking charge of a patient in labor.

The Patient.

The aseptic preparation of the obstetric patient ought to begin weeks before the labor. She is to be taught the importance of daily bathing and of strict cleanliness of the external genitals and the adjacent skin surfaces. Diseased conditions of the rectum, the vulva, or the bladder should, as far as possible, be relieved. The character of the vaginal discharge should be learned in the antepartum examination. Discharges which are copious, which are yellowish or greenish, which excoriate the skin or are ill-odored, call for treatment of the diseased vagina and cervix. Douching twice daily for two or three weeks with a 1 : 5000 bichloride solution, or with a 2 per cent. lactic-acid solution, is usually attended with marked improvement. The mercurial is to be followed immediately with a plain sterilized-water injection to prevent absorption of the chemical. It is advisable that all interference within the vagina cease at least three days before the labor, if possible.

In health the vaginal secretion of the pregnant woman is germicidal, and in normal conditions, therefore, no antepartum douching is permissible. Irrigation is not only useless, but by washing away the vaginal secretion and by impairing the secretory activity of the vaginal walls it disturbs the natural protective agencies against sepsis.

At the beginning of labor the nurse is instructed to give the patient a full bath and a change of linen. The lower bowel is emptied by an enema and well washed out.

The external genitals and the entire lower half of the body are rendered aseptic. The technique is similar to that employed for cleansing the obstetrician's hands. The vulvar hair may be clipped short, and finally a sterile compress saturated with a mild antiseptic, like boric acid or Thiersch's solution, or even a weak sublimate solution (1 : 5000), is applied over the vulva. This is worn during the first and second stages of labor. In hospitals the lower extremities are usually enveloped in sterile coverings, and the table or bed on which the delivery takes place is dressed with steam-sterilized sheets.

The Lying-in Chamber.

If practicable a large well-ventilated room with a sunny exposure should be selected for the lying-in chamber. It is essential that the air be frequently renewed and be not exposed to contamination by reason of defective plumbing, or other avoidable sources of impurity. An open fire in suitable weather aids in maintaining the supply of fresh air. The recent presence of septic disease in the room renders it obviously unsuitable. It is well to have the hangings cleansed and the entire room freed from accumulated dust a few days before the labor. It is not necessary that the room be stripped of its usual furnishings, provided they are clean. One or two small tables for holding instruments, sterilizing-basins, hand-brushes, etc., should be available. Should an operating-table be required in case of artificial delivery, the usual kitchen-table is suitable.

Nurse's Preparations. The nurse has ready, in advance of the labor, a dozen towels and a half-dozen or more bed-sheets, two rubber sheets, large enough to cover the entire width and the greater part of the length of the bed. A labor pad, consisting of a square sack of cheese-cloth filled with surgical cotton or other absorbent material, should be provided. It is to be placed under the patient during labor as a convenient dressing for taking up the discharges. This is made three or four inches thick and three feet square. Instead of this, a Kelly rubber pad, such as is commonly used in gynecological work, may be employed. Two dozen lochial guards should be prepared. They are made of the same material as the labor pad, and about two inches thick, four inches wide, and ten inches long. Tail-pieces are attached at each end for fastening to the abdominal binder. In the absence of these, folded napkins may be used as vulvar dressings. Scissors for dividing, and narrow linen bobbin or other suitable material for ligating, the cord are provided. All these things are wrapped in several packages, sterilized, and not opened till required for use. The nurse also has ready a hand-basin with soap and water, another for the antiseptic solution, two new hand-brushes, and glycerin or vaseline as a lubricant. These, too, must be sterile.

In hospital practice the patient's linen and the bed linen are steam sterilized at the beginning of labor. Similar precautions are to be enforced as far as practicable in home confinements. Usually in the latter class of cases it must suffice that the linen be fresh laundered. When complete asepsis is impracticable the nearest approach to it that may be possible under the circumstances is imperative. The nurse should be provided with antiseptics for use during the puerperium.

Preparation of the Bed. In family practice the patient is usually confined on a bed, or a separate cot is provided, the woman being transferred to the bed at the close of labor. In hospitals a table is employed for artificial deliveries, and this should be the rule in private practice. To protect the bed from soiling by the discharges, it is covered with a rubber sheet. Over this is spread a muslin sheet, and both are pinned fast to the mattress. A second rubber sheet may be spread over these, and that overlaid with a muslin sheet. The latter are removed at the close of labor, and the remaining rubber sheet after five or six days. When economy requires, table oilcloth may be substituted for the rubber.

For convenience the cot or bed should be so placed as to be easily accessible from both sides.

MANAGEMENT OF LABOR.

Management of the First Stage of Labor.

Examination During Labor.

Preparation of the Patient. The antiseptic preparation of the patient has already been considered. At the onset of labor the lower bowel is to be cleared and well washed out with an enema. If the first stage is prolonged the rectal injection may be once or twice repeated. Until the second stage begins the woman, as a rule, need not be confined to the bed. The progress of labor is promoted by the upright position. Yet too much walking may be inadvisable before the head engages in the pelvic brim. It may favor prolapse of an arm or the cord.

Diagnostic Signs of Beginning Labor. Precursory signs of labor are frequently observed for ten days or two weeks before active pains begin. First to attract the attention of the patient is the lightening. This generally precedes the labor by ten days or a little more. The uterus sinks more deeply in the pelvis and the waist line becomes smaller. Lightening, however, is not constant. At the same time the pressure of the uterus on the pelvic viscera is increased, and bowel movements and evacuations of the bladder occur more frequently.

Irritability of the bladder and the rectum becomes still more marked when labor begins.

The vaginal secretion grows freer as labor is established, and the mucous plug is expelled from the cervix in the form of a gelatinous mass.

A slight discharge of blood or of blood-stained mucus, the *show*, may be observed. Yet the show and the expulsion of the mucous plug are not always noted.

Inquiry should be made with reference to the frequency, strength, and duration of the pains and the time when they began.

Most significant of actual labor are rhythmic uterine pains, with evidence of uterine contraction during the pains as elicited with the hand on the abdomen over the uterus.

Abdominal Examination. The general plan and method of the abdominal examination during labor are substantially the same as in the antepartal examination.

The size of the fœtal head should be estimated as accurately as possible by palpation, or by measurement with the pelvimeter through the abdominal wall and by observing how far it sinks into the pelvic brim or may be made to do so by suprapubic pressure.

The stage of progress may be determined approximately in the abdominal examination by noting how deeply the head has sunk into the true pelvis. When the head has not yet engaged, if the membranes are still unbroken, it may usually be pressed up out of the excavation by placing the hands on the abdomen over the sides of the head and sinking the finger-tips into the pelvic brim. After engagement of the head the relation of the base of the skull to the pelvic inlet is made out by deep palpation above the pubes. The height of the anterior shoulder, too, is learned by palpation, and it helps in deciding how far the head has descended.

The signs of a possible face presentation should be looked for in the abdominal examination during labor. The extension of the head which causes the face to present develops only after the pains begin.

The rate and force of the fœtal heart are to be noted and to be listened for at intervals throughout the labor. A fœtal pulse below 120 or above 150 to the minute is a probable indication of danger to the child.

A distended bladder presents a tense fluid tumor between the uterus and the lower part of the abdominal wall. It is readily recognized by palpation over the suprapubic region.

Vaginal Examination. Before examining internally the hands must be disinfected. This part of the examination aims to determine the condition of the vulva, the vagina, the cervix, and the bony pelvis, and o verify the diagnosis of fœtal presentation and position as made out by he abdominal examination. Possible anomalies, too, of the fœtus that may complicate the labor should be recognized.

The resistance likely to be offered at the vulva as the head descends, the lubrication of the vagina, the degree of dilatation of the cervix, the thickness and consistence of the cervical border, the presence or absence of injuries sustained in former labors are to be noted.

For the internal examination the patient lies on the back with the knees drawn up. The examiner separates the labia with the thumb and fingers of one hand and introduces the examining finger or fingers of the other hand into the vagina.

Vertex presentation is recognized by the hard and globular character of the cranial portion of the fœtal head and by the presence of sutures and fontanelles.

The position is made out by locating the sagittal suture and learning which end is forward, or by finding in which quadrant of the pelvis the smaller fontanelle lies. It is not always practicable to reach the large fontanelle. Great care is required to identify the anatomical landmarks of the presenting part, especially when they are obscured by œdematous swelling. Every accessible part of the presenting pole should be searched with the examining fingers, using firm pressure. For the diagnostic signs of other than vertex presentation the reader must be referred to the chapters treating of those presentations.

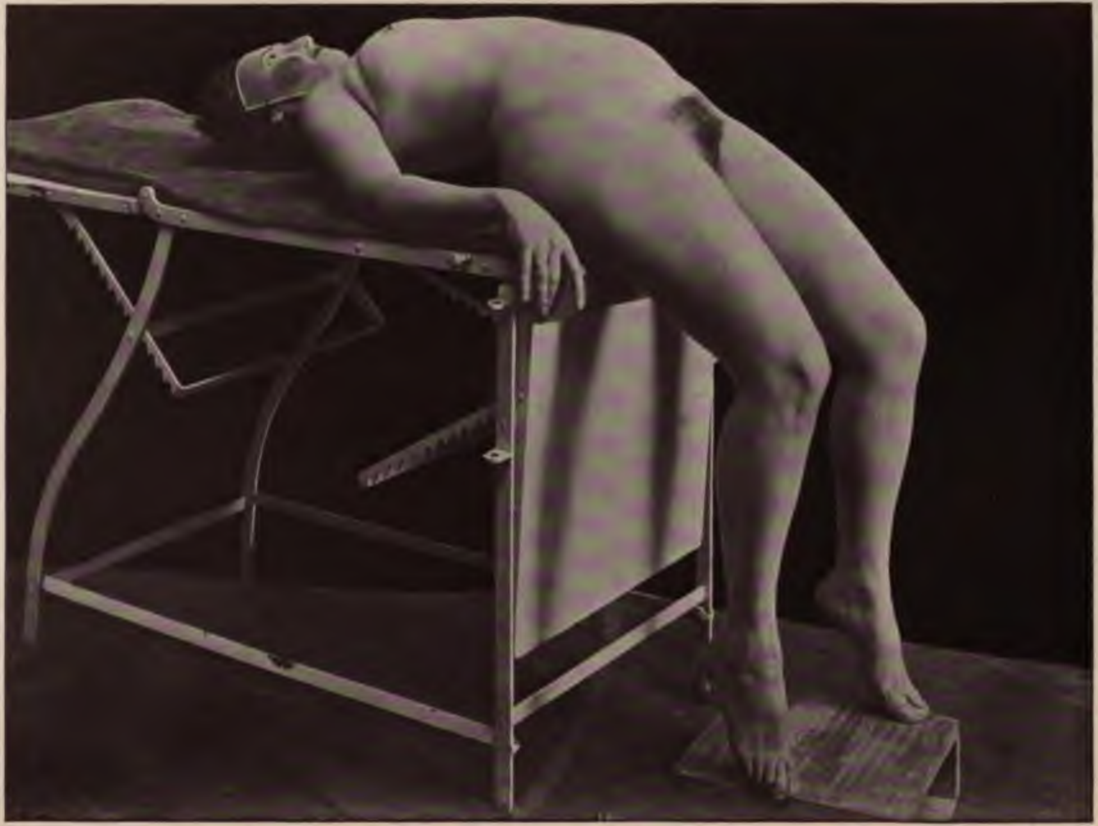
Prognosis. Definite predictions as to the duration of the labor are seldom possible. Conditions which determine the prognosis are the relative size of head and pelvis, the hardness of the head, the degree of descent, the thinness and softness of the cervix, the presence or absence of complications, and the strength and efficiency of the pains. But it is impossible to foretell with certainty the character of the pains. Yet the patient is entitled to such assurance and encouragement as can reasonably be given.

Patient to Remain Out of Bed. As a rule, the patient should not be confined to bed during the first stage. She is usually allowed the liberty of the room. Much walking may hinder the engagement of the head, and is not advisable before the head has sunk into the excavation. A slow labor will be accelerated by moving about and even by the standing or sitting position; in over-rapid labor the woman should maintain a reclining posture on the bed or couch. The course pursued must be determined by the circumstances of the individual case.

Frequency of Vaginal Examinations. A properly conducted internal examination with surgically clean fingers entails practically no risk of infection. Yet abundant statistics have shown that the best puerperal results are obtained when it is possible to refrain wholly from internal interference. All unnecessary manipulations within the passages should be avoided. If a thorough antepartum examination has been made a single vaginal examination during the first stage of labor will usually suffice. This is generally advisable, to make sure that the cord or an arm has not prolapsed and that no other complication has developed. Should any irregularity occur repeated examinations may be required.

General Rules. In the absence of complications the attendance of the physician during the first stage of labor is not required, except in so far as is necessary to keep him advised of the rate of progress. Except in very slow labor the physician ought to be present in the house from the time the dilatation of the cervix is nearly complete. Unnecessary manipulation of the cervix is especially to be avoided. It impairs the

PLATE XVIII.



Walcher's Position.

local resistance against infection. Lifting the anterior portion of the cervix over the occiput is permissible only when the anterior lip retards abnormally the progress of labor. Light food may be allowed during the first stage. Pain, if severe, may be relieved by chloral. From 45 to 60 grains may be given in doses of 15 grains every fifteen minutes in plenty of water.

Management of the Second Stage of Labor.

The management of physiological labor in the second stage, as in the first, should be mainly expectant. So long as all is normal the rôle of the obstetrician is little more than that of a passive observer.

From the time the second stage is about to begin the patient must be in bed, and she must not, as a rule, be permitted to leave it even for evacuations of the bladder or the bowels. She is to be dressed in her usual night clothing, which is turned up and pinned at the shoulders to protect it from soiling. For still further protection of the patient's linen, the lower half of the body may be covered with a folded sheet fastened at the waist like a skirt.

A slow labor may be accelerated or an over-rapid labor retarded, when possible by resort to simple measures. Inefficient pains are to be reinforced by summoning the aid of the abdominal muscles. Encourage the patient to hold the breath and bear down as the pain reaches its height. She may now and then assume a sitting posture on the edge of the bed. Bracing the feet and pulling upon the hands of a bystander or on a sheet-sling help the expulsive efforts. The sling is made by folding a sheet at diagonally opposite corners and twisting it loosely into a rope. One end is fastened at the foot of the bed and the patient pulls at the other. Sometimes a moderately firm abdominal binder may be useful.

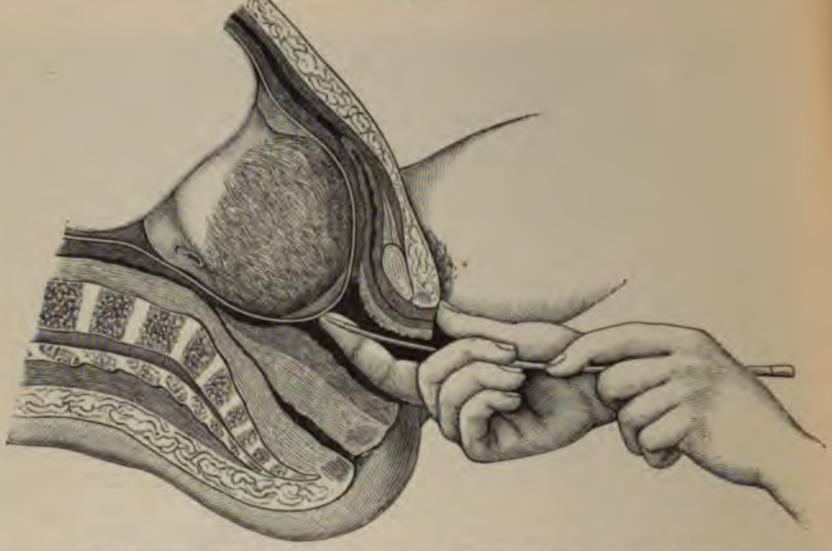
In too rapid labor the foregoing measures must be withheld and the pains retarded if necessary by the use of chloroform.

Obstetric Positions. The choice of position in the expulsive stage of labor is usually left to the patient. Her comfort is promoted and the pains are stimulated by occasional changes of posture. For internal examinations either the lateral or the dorsal position may be chosen. The latter is generally preferred. A semi-recumbent or a sitting posture favors the pains owing to the influence of gravity.

WALCHER'S POSITION. By reason of the nutation of the sacrum the antero-posterior diameters of the pelvic inlet are slightly increased when the woman lies on the back with the thighs hanging in extreme extension over the edge of the bed or table. (Plate XVIII.) Advantage may be taken of this fact, especially in difficult labor, while the head is passing the brim. At the outlet of the pelvis, on the other hand, the sacro-pubic diameter is perceptibly increased when the thighs are strongly flexed on the abdomen. For this reason, as well as for convenience in managing the birth of the head, the lateral position with the knees drawn up is usually to be preferred from the time the head approaches the pelvic outlet.

Vaginal Examinations. In strictly normal labor there is little occasion to examine internally after the second stage is established, except for observing the rate of progress. With practice even the degree of descent may be learned almost as surely and as readily by external palpation, and vaginal examination may, in simple labor, be omitted. By palpating over the suprapubic region the head can be made out till it has sunk deeply in the excavation. The occiput from the time it has reached the outlet of the bony pelvis can be felt by deep pressure with one or two fingers applied externally over the pelvic floor. While there is practically no danger of infection in the vaginal examination conducted under proper aseptic precautions, yet the best puerperal results, as already stated, are attained when no internal manipulation is practised. Should the labor be unduly prolonged or be otherwise abnormal, repeated internal examinations may be required to determine the cause.

FIG. 204.



Instrumental puncture of the membranes. (RIBEMONT-DESSAIGNES and LEPAGE.)

Rupture of the Membranes. The bag of membranes usually breaks spontaneously by the time dilatation is complete, frequently earlier. Sometimes it gives way at the onset of labor. In normal labor after the protruding bag has reached the pelvic floor, it no longer serves any useful purpose. If it still persists it should be ruptured artificially. Usually this may be done with the finger-nail while the sac of waters is tense during a pain. This failing, a sharp-pointed scissors, a straightened hairpin, or other suitable perforator, may be used. The instrument is sterilized and passed with its point resting on the finger-tip as a guard and a guide (Fig. 204.) A mere prick suffices, the membranes tearing readily when once punctured.

Obstetric Anæsthesia. In obstetric as distinguished from surgical anæsthesia, the object is to blunt, not wholly to abolish the sensibilities. The use of anæsthetics for this purpose in labor is justified on both humanitarian and scientific grounds. It is not only the plain duty of the obstetrician to relieve the needless sufferings of his patient, but the judicious employment of anæsthetic agents spares her unnecessary exhaustion. It must not be forgotten, however, that the prolonged or too free use of anæsthetics is capable of harm. When pushed beyond the stage of mere analgesia they lessen the strength and frequency of the uterine contractions. While seldom causing death, they are not infrequently contributing factors in the fatal issue. Doubtless the abuse of anæsthetics may be a predisposing cause of sepsis, by favoring relaxation of the uterus and by impairing the resisting powers. They should be withheld so long as the pains are well borne without them. They are more especially called for in the latter part of the expulsive stage of labor. At the acme of expulsion the anæsthetic should, as a rule, be pushed nearly or quite to the surgical degree.

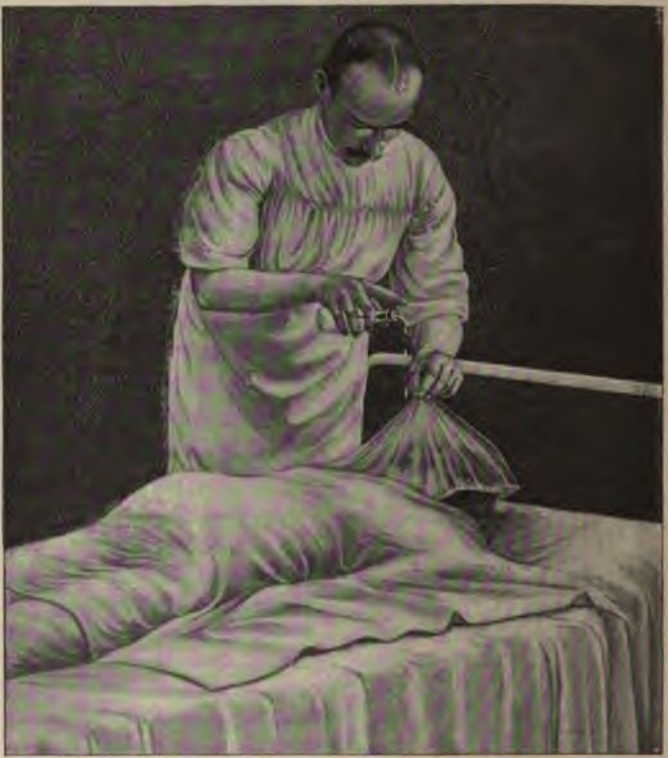
Choice of Anæsthetics. For mere obstetric analgesia chloroform is generally preferred. It has the advantage over ether that it is pleasanter; the necessary quantity, too, is less bulky, and is, consequently, more conveniently carried in the obstetric bag. On the other hand, it is not so safe as ether, and possibly it impairs the strength of the uterine contractions more than does the latter agent. It is a powerful vasomotor depressant and its too free use may paralyze the arteries and incapacitate the heart. Theoretically it is especially dangerous in the third stage of labor.

For obstetric operations in which full narcosis is required, chloroform, as a rule, gives place to ether. By some obstetricians the latter anæsthetic is preferred for general obstetric use. It is no less manageable than chloroform for all obstetric purposes, and, as its advocates believe, it does not weaken, but rather stimulates, the uterine contractions. In the presence of bronchitis ether is unsuitable, owing to its irritant effect on the respiratory mucous membranes. In atheromatous disease it is dangerous, since it increases the vascular tension. Chloroform is to be preferred in eclampsia and in tetanic contraction of the uterus.

Method of Administration. In obstetric anæsthesia the anæsthetic may safely be given by a competent nurse under direction of the physician. Narcosis to the surgical degree for operative intervention should be trusted only to a skilled medical assistant. It is desirable that the patient shall have taken no solid food for several hours before anæsthesia, especially if the narcosis is to be carried to the surgical degree. The head is lowered to the level of the body, if chloroform is to be given, all constricting bands of clothing are loosened, and the region of the mouth and nose smeared with glycerin. The latter precaution is required to prevent injury to the skin by contact of liquid chloroform or of its concentrated vapor. The patient is requested to remove false teeth or other foreign bodies from the mouth. The heart is examined; yet the presence of cardiac disease does not necessarily forbid the use of anæsthetics. Usually the shock of difficult labor, and especially of operative interference, is more dangerous without than with the anæsthetic. Yet a weak heart calls for special caution in the use of these agents.

Mode of Administration. For ordinary obstetric anæsthesia a coarse towel is a good inhaler. It is placed over the patient's face and held by the middle, which is lifted six or seven inches from the face. (Fig. 205.) A large cone-shaped air-chamber is thus formed which insures ample dilution of the anæsthetic vapor. Instead of this an Esmarch mask or an Allis inhaler may be used. The anæsthetic is dropped upon the inhaler opposite the patient's mouth and nose. Except when complete narcosis is desired it is given only with the pains. To develop its effect by the time it is most needed, when the pain has reached its height, the inhalation must begin promptly at the beginning of the pain. If chloroform is used only a single drop is let fall on the inhaler with each breath. If ether is employed three or four drops will be required at each inspiration. To increase the effect of the drug, if necessary, ask the patient to breathe rapidly as the inhalation begins. The administration is stopped by removing the inhaler as soon as the pain is about to subside. The drop-by-drop method should be insisted upon for either obstetric or surgical anæsthesia. It insures at once the greatest possible safety and the least discomfort in the use of either chloroform or ether.

FIG. 205.



Giving chloroform with the towel-inhaler and dropping-bottle.

At the acme of expulsion, as the head is passing the introitus, the anæsthesia should generally be pushed to full unconsciousness. This not only spares the woman the severer pangs of labor, but by retarding expulsion and by relaxing the muscular structures of the pelvic floor it lessens the risk of lacerations at the vaginal outlet.

Complete anæsthesia when required for obstetric operations during the birth or during the third stage of labor is to be managed in accordance with the well-established rules of surgical practice.

Intraspinal Cocainization. The injection of cocaine into the spinal canal has been practised by Kreis, of Germany, Marx, of New York, and others, for obstetric analgesia, with satisfactory results, but the method offers no apparent advantage over other anæsthetics for general obstetric use.

The Perineal Stage of Labor. The management of labor at the acme of expulsion is chiefly concerned with the prevention of injuries to the pelvic floor. Normally the soft parts at the vulvo-vaginal outlet of the birth-canal yield without tearing under the gradual advance of the fœtal head and escape important injury. Yet notable laceration of the pelvic floor occurs in about 35 per cent. of term labors in primiparæ, and nearly a third as often in women who have been delivered before. Rupture of the fourchette is the rule, and is unimportant. Minor tears may occur at any part of the vulvo-vaginal ring. The more important lesions are those of the posterior segment of the pelvic floor near the median line.

More or less extensive laceration is frequently unavoidable in fœtal malposition, in narrow pelvis, in relatively small vaginal outlet, and in undue rigidity of the pelvic floor from defective development, œdema, or other causes. On the other hand, at least half the pelvic-floor injuries occurring in general obstetric practice are preventable by skilful management of the perineal stage of labor.

Prevention depends on the distensibility of the pelvic floor and the smallness of the engaging circumference of the fœtal head.

The relaxation of the floor is promoted by slow and gradual delivery of the head, permitting the structures to stretch. Over-rapid expulsion frequently results in laceration. It is seldom that the head can safely be permitted to escape in first labors in less than twenty to forty minutes from the time the pelvic floor begins to bulge. Half this time may suffice in subsequent labors.

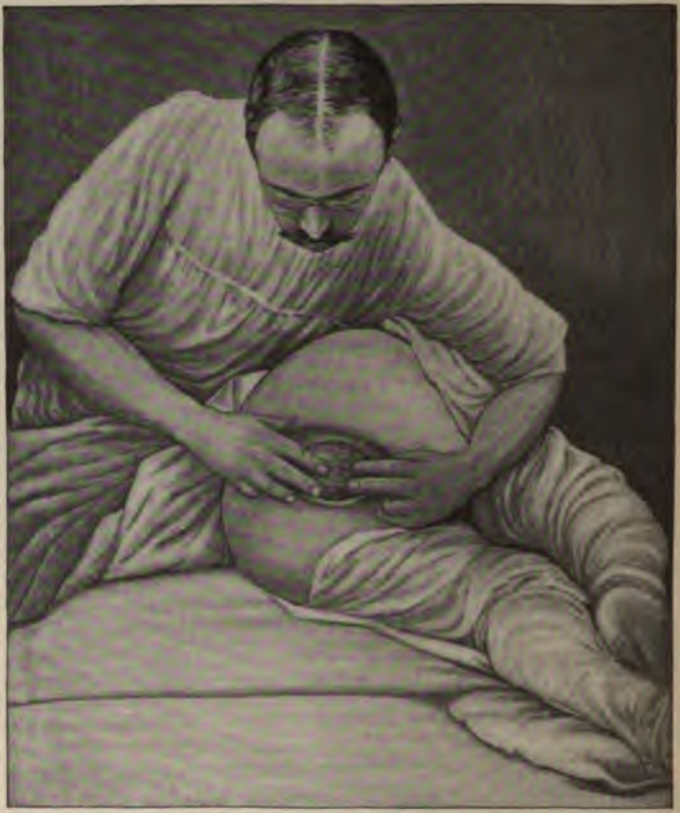
The mechanism of expulsion must be so regulated that the smallest circumference of the head is constantly kept in the grasp of the resisting girdle. Moreover, the direction of expulsion must be controlled lest the soft parts be subjected to too great strain by misdirection of the driving force.

From the time the head approaches the pelvic floor the labor is best managed with the patient lying on the side, especially in primiparæ. The hips are brought close to the edge of the bed. The obstetrician standing or sitting by the side of the bed has complete command of the rate and mechanism of expulsion. For some time before the occiput appears at the vulvar orifice the head can be felt without examining internally by pressing the fingers against the pelvic floor. The rapidity of descent may thus be watched till the occiput begins to protrude during the pains.

From this period, if not for a longer time, the parts should be under ocular inspection. The rate of descent is moderated by moderating the action of the abdominal muscles by the use of chloroform, and by direct pressure with the fingers held against the uncovered portion of the head. The head is permitted to descend only so far at each pain as can be done without exposing the tense structures to risk of tearing. The degree of tension is estimated by occasionally passing the finger just within the resisting vulvar ring at the height of a pain.

To secure delivery by the smallest circumference of the head too extension must be prevented. Keep its long axis in the axis of outlet till the equator of the head has passed. To relieve the p floor from undue strain by misdirection of the expelling force, pres head firmly up into the subpubic arch as it is about to escape.

FIG. 206.



Regulating birth of head.

All this may be effected without pressure upon the pelvic floor. no harm need be done by properly guarded pressure against the through the floor. With the thumb laid along one side of the v and the fingers along the other, and the palm of the hand resting bro over the perineum, the head can be carried well up into the subp space and the rate and mechanism of delivery be readily contro The object of this manœuvre, however, is not support of the floor, regulation of the head movements.

For the execution of any of the foregoing manipulations the oper may assume the position shown in Fig. 206 during the expulsion of head. Sitting on the bed behind the patient, two or three finger each hand are held upon the head, or one hand is placed on the and the other on the part of the pelvic floor which overlies the hea

A basin containing the antiseptic solution should be placed near the bed. With a piece of sterile cheesecloth dipped in the antiseptic, the protruding portion of the head and the surrounding perineal surfaces are cleansed as often as soiled by the discharges. To protect the hands from soiling with fecal matter it is well to keep the anal orifice covered with an aseptic towel wet with the antiseptic solution during the manipulations required at the expulsion of the head.

Episiotomy. When extensive laceration at the vaginal outlet is otherwise inevitable incisions may be made on either side. Episiotomy substitutes for a posterior laceration, which is often difficult of complete repair, incisions through less important structures, which can easily and perfectly be closed by suture. The incisions are made about one-third way from the median line posteriorly when the parts are stretched during a pain. They should be about 6 mm., $\frac{1}{4}$ inch, deep, and 2.5 cm., 1 inch, in length.

It is needless to say that to be of service the episiotomy cuts must anticipate the tearing, yet the necessity for them cannot be determined, nor can they be effected properly till the parts are well stretched by the protruding head.

During a pain a finger is passed within the vulva by the side of the head till a cord-like girdle is felt. A blunt-pointed bistoury is then slipped flatwise between the head and the tense ring. Holding it in a line parallel with the long axis of the mother's body the edge is turned outward and the girdle is cut. The incision is repeated on the opposite side of the vulvo-vaginal orifice. Should the mistake be made of holding the knife in the direction of the outlet of the soft parts, instead of the long axis of the mother's body, it will be found after delivery that the tip of the blade has invaded the median portion of the pelvic floor, incising the very structures which the operation was intended to save. A strong blunt-pointed scissors may be substituted for the bistoury if preferred.

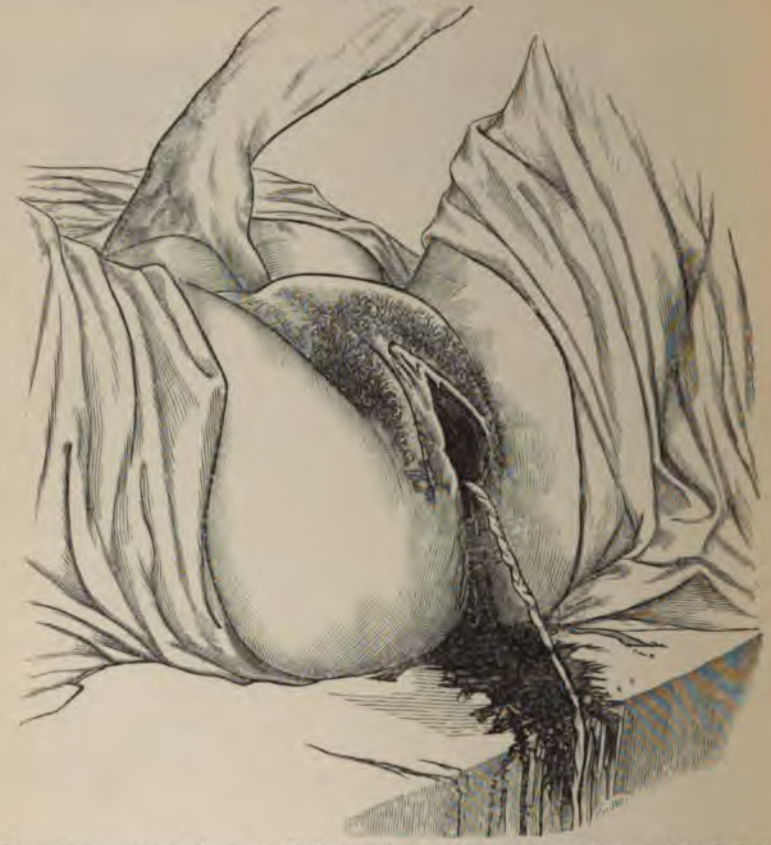
After delivery the incisions are sutured. This is easily effected with the patient on the back, or, better, on the side. In the latter posture the uppermost cut is sutured first. The field is thus unobscured by blood which drains from the vagina over the dependent side. The position is then reversed for closing the other incision.

Management of the Birth of the Trunk. On birth of the head examination is promptly made to learn if the cord is coiled about the neck. If it is, the loop or loops are drawn down successively over the head. Should the attempt fail, which can scarcely be possible, the cord is divided with scissors and the trunk at once extracted. The head is supported with the hand, in the axis of expulsion. The delivery of the trunk is left to the natural forces unless reason appears for hastening the extraction. It is not advisable to drag the child unnecessarily from the uterus in the interval between contractions. As a pain comes on a finger is hooked in the posterior axilla from behind. The shoulder is pressed forward toward the child's sternum and is lifted over the perineal edge while the anterior shoulder still rests behind the symphysis. The posterior arm is now extracted and the remaining shoulder escapes under the pubic arch. When for any reason immediate delivery of the child by traction is required, the uterus should be stimulated to contract as the trunk is delivered, by friction with the hand upon the abdomen.

Management of the Third Stage of Labor.

From the moment the head is born one hand of the obstetrician or assistant is held on the abdomen over the uterus. So long as the uterine contractions go on normally after the child is expelled, only light pressure and no friction or other manipulation is to be used. Should the uterus remain too much or too persistently relaxed, contraction may be stimulated by gentle friction, moving the abdominal wall with the hand, slowly and in a circular direction, over the anterior wall of the uterus. If more active measures are called for to evacuate the uterus, the fundus may be grasped firmly with one or both hands.

FIG. 207.



Manual expression of placenta. Method of Credé. (BEERS, from a photograph by H. F. J.)

Credé's Method of Expressing the Placenta. The uterus is thus watched for half an hour after the birth of the child. If by this time the placenta has not been separated and expelled by the unaided contractions, resort is had to Credé's method of expression. This is practised as follows: The fundus is grasped with the thumb in front and the fingers behind and a uterine contraction awaited. As the pain reaches its height the fundus is forcibly compressed with the hand and at the same time forced gently downward in the pelvis. (Fig. 207.) The efficiency of the manipulation is greatly increased if the fundus is also crowded backward to bring the uterine more nearly in line with the vaginal axis. Should the first attempt fail, it is repeated with each successive contraction till the afterbirth is expelled from the uterus.

If the compression is practised at the acme of a pain, and at the same time the woman is required to strain forcibly, the placenta is almost invariably expelled at the first attempt.

Manual Extraction of the Placenta. The uterus is to be watched with the hand over the abdomen for half an hour longer till retraction is fully established. Friction or more vigorous manipulation is applied from time to time only as required to maintain normal contractions. If the placenta still remains in the vagina or lower uterine segment, it is drawn down by gentle traction on the cord. When it presents at the vulva it is caught with the hands and careful traction made to separate the membranes should they still be partially adherent.

Examination of the Placenta and Membranes. On expulsion the maternal surface of the placenta is carefully examined to see that no fragment has been left behind. The membranes are also inspected to make sure that both amnion and chorion are complete. This is best done by transmitted light. As a matter of scientific interest, the weight, size, and shape of the placenta, the length of the cord, the site of the umbilical insertion, and the presence or absence of anomalies may be noted.

Retraction of the Uterus. Should the uterus not retract promptly and firmly after the expulsion of the placenta, contractions are stimulated by friction with the hand on the abdomen. When more active measures are required, a half drachm of fluid extract of ergot may be given and repeated p. r. n. One or two doses of ergot are generally advisable when the uterus remains much relaxed, and especially after chloroform anæsthesia. In small doses this agent is practically harmless, and it fulfils more than one important indication in the management of the final stage of labor. It is useful as a prophylactic, not only against hemorrhage but against sepsis. By maintaining contractions it tends to prevent the accumulation of blood-clots in the uterus, to lessen afterpains, and to close the avenues of absorption. By limiting the blood-supply it promotes involution. The uterus must be watched with the hand on the abdomen till retraction is complete. This will require the attention of the physician or nurse for not less than half an hour.

Care of the Child. On birth of the head the nurse cleanses the face and especially the eyes of the child, the latter best with a saturated boric acid solution or other mild antiseptic. The eyes are carefully dried. This precaution is taken for the prevention of ophthalmia, and is doubly important should there be reason to suspect that the vaginal discharge is infectious. In hospital practice a drop of a 2 per cent. solution of silver nitrate, Credé's solution, or better, a 10 per cent. solution of protargol, is instilled into each eye of the child at birth. This rule may well be carried out in family practice, and in the presence of a gonorrhœal, septic, or diphtheritic vaginal secretion is imperative. The application is harmless, and is almost an absolute preventive of purulent conjunctivitis in the new-born.

On the complete expulsion of the child steps should immediately be taken to fully establish the respiratory movements. Mucus in the pharynx may be removed with the finger wrapped with a soft wet piece of cheese-cloth. Still better is a soft rubber tube with a rubber bulb attached. The mucus is sucked up into the tube. Holding the child suspended by the feet favors drainage from the respiratory tract, should it contain liquor amnii or blood drawn into it by premature attempts at respiration.

The contact of cool air with the moist surface of the body, as well as the air-hunger created by the partial interruption of the utero-placental circulation, usually excites respiratory movements. Directly after birth, should the child not promptly begin to breathe, the action of the respiratory muscles may be stimulated by gentle flagellation over the buttocks, by dashing a little cold water upon the face and chest, or by forcibly blowing upon the face.

The treatment of asphyxia neonatorum will be considered in the chapter on Anomalies and Diseases of the New-born Infant.

Ligation of the Cord. The ligation of the cord should, as a rule, be delayed till the child is breathing freely. The infant thus gains from one to three ounces of blood. This post-natal afflux of blood is due to the force of thoracic aspiration. While of comparatively little moment in robust infants, it is often a matter of vital consequence in premature, puny, and feeble children.

The utmost aseptic care must be observed in ligating and dividing the cord. Fatal infection of the umbilical vessels may result from the neglect of proper cleanliness. Ligature and scissors, as well as the hands and everything that comes in contact with the umbilical stump, must be surgically clean. Before tying the cord the physician assures himself that no hernial protrusion has taken place into it. Firm pressure is applied with the thumb and fingers at the point to be ligated to press out the jelly of Wharton. This lessens the risk that hemorrhage may occur from loosening of the ligature by shrinkage of the stump. The ligature, which may be of narrow linen bobbin about a sixteenth inch in width, is then applied and tied tightly about three-fourths of an inch from the cutaneous junction. The cord is cut with scissors a quarter of an inch beyond the ligature. The end of the stump is pressed with a sterile cheese-cloth to see if its bleeds; should it do so it is tied again. The maternal end of the cord need not, as a rule, be ligated. In case of twins the second ligature should not be omitted, lest the undelivered child perish from blood-loss should the placental circulations communicate.

The child is wrapped warmly and laid in a warm place till the necessary attentions to the mother are completed.

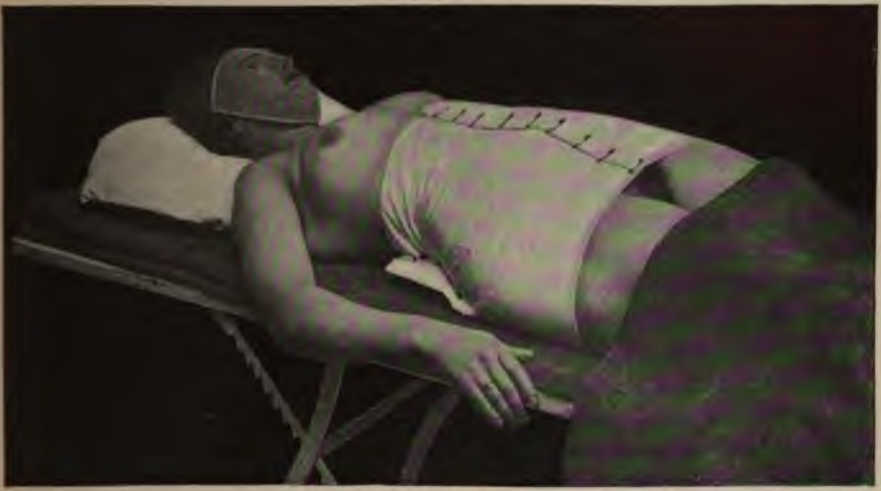
Examination of Mother and Child. The physician assures himself of the general condition of the mother, and especially of the pulse-rate, and again examines the uterus with the hand on the abdomen. A careful inspection is made of the vulvar orifice for possible lacerations. Notable injuries should, as a rule, immediately be sutured. The method of suture will be found detailed in the chapter on the Treatment of Lacerations.

The child is carefully examined for the possible existence of developmental anomalies.

Vulvar Dressing. The nurse cleanses all soiled portions of the mother's body, bathing the external genitals with an antiseptic solution, and she removes all soiled linen from the patient and the bed. The vulva is covered with an aseptic napkin which is fastened behind and in front to the abdominal binder when the latter is applied. Instead of the napkin the special dressing already described may be used. These dressings are burnt after once using. Their object is to receive the discharges and, through frequent changing, to promote the cleanliness of the external genitals.

Abdominal Binder. A moderately firm bandage about the abdomen adds to the comfort of the patient after labor. It may be fairly tight for the first twelve hours for support. After that time it should be slightly looser. This is discarded by the time the woman leaves the bed or earlier. The binder is best made of strong unbleached muslin. It should be wide enough to reach from the great trochanters to the ensiform appendage, and long enough barely to permit the ends to overlap after encircling the body. It is pinned with shield-pins in the median line in front, and then made tight by pinning a fold at each side (Fig. 208). If compresses are used under the binder, one should be placed above and one on each side of the uterus.

FIG. 208.



Abdominal binder.

Final Duties. Before leaving the physician again takes note of the condition of the mother, and examines the child to see that all is normal. The nurse is given full instructions with reference to the care of the mother and child. One or two doses of ergot and a prescription for relieving after-pains are left, to be used if required.

PART IV.

PHYSIOLOGY OF THE PUERPERIUM.

CHAPTER X.

THE PUERPERAL STATE.

Definition. By the puerperal period is meant the time which elapses after childbirth during which the changes observed in the course of labor and pregnancy are being effaced and the body is returning more or less approximately to the state in which it was before impregnation. But, since these progressive and retrogressive alterations chiefly involve the generative organs, we may leave out of consideration the general constitutional changes, and for practical purposes limit our definition so that the puerperium may signify "that period after labor in which the genitalia are regaining the condition proper to those of the non-gravid woman." In the case of women who have previously borne children, the condition reached at the end of the puerperium should, except as regards the inevitable local changes, be that observed before the last pregnancy. In the case of primiparæ, the previous nulliparous condition is never regained. Certain changes have taken place in the genitalia and in the abdominal walls which are permanent and which are accompanied with more or less certain indications that at least one labor has occurred.

The puerperium may, therefore, be said to begin immediately after the delivery of the placenta and to end with the complete involution and regeneration of the internal genitals. Exact anatomical observations have proved that the processes involved usually take about six weeks. Between individual cases the variations may be considerable. It is interesting to note that the limits of the period had been established long before our modern scientific methods of examination were known. It is not hard to see how the older obstetricians made so correct calculations. Experience had taught them that after six weeks the normal functions of the non-impregnated genitalia—namely, menstruation and conception—could begin again. It is true that in nursing women menstruation rarely occurs at so early a date, but it is a well-known fact that it is possible for them from this time forward to conceive again, the possibility becoming greater every month.

Introductory Remarks. Pregnancy, labor, and the puerperal state are, under ordinary circumstances, natural processes, but in all of them the physiological borders so closely upon the pathological that it is extremely difficult to draw a hard-and-fast line between the two. Of necessity, then, in descriptions of the so-called normal puerperium and its management, it is almost impossible to avoid touching upon certain minor pathological conditions, which are not severe enough to bring about any serious results.

The puerperal woman has been aptly compared to a person suffering from a recent more or less severe wound. Provided the patient has been in a normal condition previously, and that the wound be not too severe and can be kept surgically clean, beyond the weakness caused by pain, loss of blood, and a certain amount of nervous shock, there is nothing to interfere with a speedy recovery. But once allow infectious material to enter the wound, a series of pathological processes ensue which materially alter the features of the case. In the puerperal woman we have to deal with open wounds extending over a large surface, a contused condition of the genitalia, exhaustion following labor, and a condition of more or less marked nervous shock. Here, then, we have a condition physiological, perhaps, but easily transformed into a most serious pathological state. Everything, it may be said, is present which would render the occurrence of infection peculiarly easy. The open wounds and contused surfaces offer a decreased local resistance; the lochial discharge and the blood-clots in the uterine sinuses at the placental site form excellent media for bacterial growth. The very number of the small lacerations increases the chances that any poison introduced may find a congenial nidus where it can produce a localized pathological process or from which it can spread and infect the whole system. Added to this we have the general weakness and exhaustion of the whole body, which offers decreased resistance to the attack of any pathogenic agent. Thus it will easily be seen that for the bringing about of a normal puerperium prophylactic measures play the most important part, and when complications arise after a normal labor the obstetrician has always to ask himself how far he has been responsible for their existence and in what way his technique has been faulty. Nothing can be more satisfactory to the physician than to see his patient who has just undergone perhaps the most severe trial and suffering which she has ever experienced, regaining almost perceptibly from hour to hour her former health and strength, and nothing is more painful to watch than the course of a puerperal infection, which if not fatal is always serious, and may leave behind it irreparable damage, especially when he has to confess that the cause for the whole trouble probably lies in some apparently trivial error, either of omission or commission, which has occurred in the course of what should be a physiological process.

We shall now take up in detail the changes which take place in the genitalia during the puerperium.

Outlet and Vagina. In primiparæ the hymen and the fourchette are almost invariably torn, and such tears are of no import. Deeper lacerations, especially those extending into the perineal body or into the bowel, though at times not preventable, must always be considered as pathological. The tear in the hymen is usually stellate, and after involution traces of the membrane are found in the small bodies surrounding the outlet, the so-called carunculæ myrtiformes. The whole vagina has been dilated during labor, but, though in all cases microscopic lacerations probably occur, the elasticity of the tissues of the canal generally prevents the occurrence of any serious injury. The external and internal parts, however, are always more or less contused, œdematous, and hyperæmic. Small lacerations usually heal spontaneously, if kept clean. The more serious tears, when coaptation of the wounded surfaces does not occur spontaneously, if neglected, heal chiefly by granulation and cicatrization, and may leave extensive areas of scar-tissue behind them. Lacerations in the anterior wall of the vagina may give rise to troublesome vesico-vaginal, urethro-vaginal, or even vesico-urethro-vaginal fistulæ. A vesico-vaginal fistula at the site of the vesical trigone is an especially troublesome complication. Lacerations in the posterior vault and posterior wall may or may not communicate with the peritoneal cavity or rectum. Superficial tears in this region are not unusual. An overstretching of the outlet or lacerations which have separated some of the fibres of the levator ani muscle are frequently found. Fortunately, in many cases it will happen that at the end of the puerperium nature has rectified this condition. But in not a few instances the function of the levator ani is permanently impaired. The anterior fibres of this muscle furnish the chief support of the outlet; acting from the two rami of the pubic bone they pull the vaginal orifice upward and forward away from the direct line of intra-abdominal pressure. If, therefore, the function of these fibres be put in abeyance prolapse of the vaginal walls and descent or prolapse of the uterus must almost certainly follow. The treatment of serious tears or overstretching of this muscle has been discussed elsewhere.

Normally the small tears of the vagina soon heal promptly, sometimes by first intention, despite their continuous lochial bath. More or less extensive cicatrices may be left behind to mark their previous situation. The vagina becomes smaller and narrower, and from being smooth becomes wrinkled, though the rugæ are never so deep or as well marked as in the primipara. The swollen, succulent, and hyperæmic condition gradually subsides. Should there occur no unusual or pathological amount of cicatrization, the vagina at the end of the puerperium will be found roomier than in the primipara and somewhat shorter. The outlet will be considerably larger than before, but should be still held up closely under the pubic arch by the action of the levator-ani muscle and be capable of effective contraction and narrowing by the joint action of this muscle and of the constrictor cunni. The rima vulvæ should be almost entirely closed.

Uterus. The uterus as a whole immediately after labor is said to weigh from 800 to 1000 grammes. It measures from 15 to 20 cm. in length, and from 11 to 12 cm. in breadth at the level of the Fallopian tubes. The wall of the upper uterine segment measures 3 to 4 cm. in thickness. The uterine cavity (sound measurement) is 15 to 16 cm. in length. The following table shows the comparative measurements of virginal and multiparous uteri, made by Sappey, Richet, and Henning:

	Virgin.	*Nullipara.*	*Multipara.*
Length of uterus	5.8 cm.	6.2 cm.	6.8 cm.
Width	3.8 "	3.9 "	4.2 "
Thickness	2.1 "	2.3 "	2.5 "
Vertical diameter of cavity . . .	4.5 "	....	6.1 "
Capacity of the uterus	....	2 to 3 "	3 to 5 "
Length of entire organ in young women		5.6 "	
Weight of virgin uterus	40 grammes.		

It will be seen from these figures that the parous is in all its dimensions somewhat larger than the virgin uterus. The cervical portion is also shorter than in the virginal condition. The arbor vitæ is partially effaced. The sound measurements of the uterus during the puerperium, as given by Hansen, are as follows:

Tenth day, 8 to 13.5 cm.
Fifteenth day, 8.3 to 11.5 cm.
Third week, 7.5 to 10.5 cm.
Fourth week, 7 to 9.3 cm.
Fifth week, 6.5 to 9 cm.
Sixth week, 6.2 to 9.1 cm.
Eighth week, 5.6 to 8.5 cm.
Tenth week, 5.4 to 7.5 cm.

Immediately after the expulsion of the placenta the fundus of the uterus should be felt as the upper extremity of a globular body half-way between the umbilicus and the upper border of the symphysis. In about six hours, however, it will be found to have risen again and to be about on a level with the umbilicus, or usually about 11 cm. above the symphysis, the greatest breadth of the uterus at the time being about 10 cm. From this time it diminishes rapidly in size, so that by the ninth, tenth, or twelfth day the fundus should be found at the level of the upper border of the symphysis, the body of the uterus lying entirely in the true pelvis. The uterus should at this time be somewhat anteverted or anteflexed. Involution also goes on in the cervical canal and in the portio vaginalis. Immediately after birth the cervix hangs down into the vagina, as a thin, flaccid ring, in marked contrast to the firmly contracted uterine body above. Gradually the tissues regain their elasticity and the regenerated portio vaginalis contracts. At first the cervical canal measures 7 cm., but already on the second day contraction has begun. At the beginning of the second week the portio vaginalis has about regained its usual size and consistence.

Uterine Muscular Tissue. During pregnancy the muscle cells are greatly increased in size, attaining from ten to twelve times their former length and from three to five times their normal breadth. Although the fact was formerly much disputed, it is now generally recognized that there is also a new formation of muscle cells. After labor, therefore, we have an enormous amount of tissue which disappears, the uterus losing in the first two weeks about a pound in weight. This takes place as a result of fatty degeneration. It is a well-known fact that if any organ or part of an organ in the body is deprived of nourishment it undergoes fatty degeneration and subsequently at least partial absorption. Now, the strong contractions of the uterus lessen the blood-supply, and by cutting off the nutrition cause the degeneration of the superabundant amount of tissue. It is clear, therefore, in the absence of sufficiently powerful contractions the uterus cannot reach, at least within the normal time, the appropriate state of involution.

It is a disputed point whether or not these enlarged muscle cells totally disappear and are replaced by newly formed cells. Some authorities hold that the majority, if not all, of these large cells are entirely destroyed, and that the involuted uterus is made up of new cells. The weight of the evidence, however, seems to favor the view that the large cells undergo degeneration only up to a certain point, and that the process then comes to a standstill, so that the atrophy ceases as soon as the cells have reached their original size. It is certain that they do not become quite as small as formerly, or if they do some of the newly formed cells must persist, since the parous uterus is always somewhat larger than that of the virgin.

The connective tissue undergoes similar changes.

Uterine Vessels and Nerves. The bloodvessels, lymphatics, and nerves have participated in the general growth during pregnancy, and have increased in length and diameter. The arteries have correspondingly thicker walls, except in the case of those which run in the decidua, where the walls are thinner than usual for vessels of so large a size. On account of their length they take a tortuous course, and many communicate directly with veins. At the placental site some of the sinuses have been closed by thrombi in the last month of pregnancy. Those which remain open till after delivery are closed by the contractions of the uterus, which bring their walls in close apposition, causing the formation of a clot, which later on undergoes organization. Other vessels of the uterus undergo pressure atrophy, and are finally obliterated, the obliteration in some cases being brought about by excessive growth of their walls. In examining sections of parous uteri, these vessels, with much thickened coats, are often met with and in many cases undoubtedly persist after the process of involution is finished.

Uterine Mucosa. The mucosa, which measures only a few millimetres in thickness, may be divided for purpose of description into two layers. The inner, which is in contact with the decidua, is very poorly provided with glandular elements, and on section seems to be made up almost entirely of decidual cells with small round mononuclear cells resembling lymphocytes scattered through it. This has been termed the "cellular layer." The outer layer is composed entirely of convoluted glands, which give to the sections a honeycombed appearance. This layer is known as the "honeycomb" or "glandular" layer. The inner or cellular layer is for the most part thrown off along with the decidua. Of the outer or glandular layer, a portion remains behind, and from it the new mucosa or endothelium is formed. The process is strongly suggestive of one of transplantation. The tubes of the glands have retained their epithelium, so that we have, as it were, islands from which the regeneration spreads, so that what at first was apparently a raw surface is gradually covered. The tissue which is not utilized in the process undergoes fatty degeneration and is gradually thrown off.

Patches of pigment are found for a considerable time in the endometrium, especially at the seat of the placenta, where they persist longer than elsewhere. The placental site is probably the last to receive its protecting coat of epithelium. This is doubtless due to peculiarities in the histological structure of the glandular layer at this point, very little trace of it being seen.

By the end of the fifth or sixth week the new endometrium is probably complete.

Tubes, Ovaries, and Parametrial Tissues. During pregnancy the tubes are elongated and somewhat thickened, the parametrial tissues are also hypertrophied, and all the adnexa are hyperæmic. After delivery this hyperæmia subsides and a physiological atrophy takes place until the organs regain approximately their original size. The corpus luteum, which may be still present after labor, gradually shrivels, and as time goes on becomes more deeply embedded in the ovary until it finally disappears or can be demonstrated only by the microscope.

Lochia. For the source of the lochia we have not far to look when we consider that we are dealing with an extensive open wound and with the removal of a comparatively large quantity of detritus from the tissues in the course of involution. From an open wound comes at first blood, and similarly in this case we have for the first few hours and days a bloody fluid, the *lochia rubra vel cruenta.* The microscopic examination of the secretion shows numerous red blood-corpuscles, portions of clots, and of decidual shreds. After a few days the secretion still stains the napkins a reddish-brown color, but the fragments have a pale yellowish appearance. The lochia after a week contain serum mixed with the coloring matter of the blood, together with scattered flat epithelial and cylindrical cells, and are called *lochia serosa.* As the external wounds gradually take on granulations, leucocytes are mixed with the secretion. These cells are at first few in number, but increase until after the end of the second week; the secretion is purulent, the *lochia alba vel purulenta.* These changes take place gradually; approximately it may be said that the lochia rubra appear for three days; the lochia serosa from the third to the eighth day contain much albumin, mucin, fat, chlorides, and phosphates, their reaction being alkaline. In the second week the lochia alba appear, containing leucocytes, fat, cholesterin, and a few connective-tissue cells. The normal acid secretions of the vagina finally give to the lochia an acid reaction. The flow from the uterus itself should always be sterile, and for the first day or two the lochia normally contain no micro-organisms. It is not, however, unusual for their presence to be demonstrable in the secretion later, and provided that they come only from the vagina their occurrence must not be considered abnormal.

The amount of the lochia has been variously estimated by different authors. Gassner, quoted by Winckel, gives the following figures:

Lochia cruenta	1000	grammes.
Lochia serosa	260	"
Lochia alba	205	"

The amount necessarily varies in different cases. Where there is faulty involution the lochia are more profuse. In nursing women the duration of the flow is generally shorter than in the cases in which the women do not suckle their children. The discharge diminishes gradually, and usually disappears entirely between the second and the sixth week.

After-pains. The changes going on in the inner genitalia are brought about principally by contractions of the uterus, occurring at more or less regular intervals, and which are sometimes appreciated by the patient, since they produce what are called "after-pains." It is to be noted that primiparæ seldom complain much of these pains, so that when they are at all marked some pathological process is generally to be suspected. In multiparæ they occur quite frequently, but can usually be easily controlled. The intensity of the after-pains is in inverse proportion to the strength of the uterine contractions during parturition, so that, as a rule, patients who have had a speedy, almost painless, labor, are apt to suffer more during the puerperium.

Urine. Notwithstanding the great activity of the skin after labor the amount of urine excreted by the kidneys should be rather more abundant in quantity than under ordinary circumstances. The woman may, however, pass but little urine at first, and after the first five or six hours the bladder may become much distended. Three factors contribute to bring about this accumulation: (1) The amount of urine passing into the bladder from the kidneys is greater than usual. (2) The expulsion of the contents of the uterus, the child, placenta, and liquor amnii, has removed quite a large mass from the maternal body, as a consequence of which the intra-abdominal pressure is decreased and the abdominal walls are flaccid, the bladder being thus allowed more room to expand and less resistance being exerted to its distention. (3) The woman, finding, perhaps, that a few drops of the urine trickling down over small lacerations of the outer genitalia cause a disagreeable smarting sensation, may thus be led almost unconsciously to retain her urine as long as possible.

The increase in amount seems to be mainly in the water, the urine being of rather a lower specific gravity than usual. The total amount of urea excreted is practically unchanged, the increase, if any, being quite insignificant. Sodium chloride is present in relatively larger amounts; phosphoric and sulphuric acids are both somewhat increased. Peptone is usually found in the urine. Its presence bears probably some relation to the involution of the uterus, since it is found from the second half of the first day after labor to the seventh day. Winckel reports a case of Porro's operation in which it was absent. Acetone is said to be a constant constitutent of the urine of puerperal women. Albumin may be found in some cases, due to a temporary renal hyperæmia, but its presence must be considered abnormal, and its persistence is always of grave import. The presence of sugar in the urine for a few days is not necessarily a serious symptom, and is commonly to be explained by reabsorption of milk-sugar from the mammary secretion. Its occurrence is not rare and is more especially frequent in cases in which there is distention of the breasts either from over-secretion or from failure on the part of the child to utilize the proper amount of milk.

Bowels. The bowels are apt to be sluggish at first, and do not move naturally for several days. This may be accounted for principally by the lessened intra-abdominal pressure. The fact that the woman receives only a liquid diet, and that the watery parts are given off in a great measure through the skin, and in the milk, urine, and lochia, leaves little solid fecal matter to be evacuated, especially if the bowels have been well cleared out before labor. That lessened peristalsis does not play much part in causing the constipation is proved by the fact that the excreta are passed along the bowels, the rectum being in many cases enormously distended.

Temperature. In view of the extensive changes which are going on in the body and the great amount of material to be absorbed and eliminated, it certainly would at first sight appear extraordinary that the process is not accompanied by grave pathological symptoms. Under ordinary circumstances it might be expected that the absorption of a pound or more of tissue which undergoes retrogressive metabolism would certainly give rise to a high temperature. Careful observations, however, based upon long experience have proved beyond doubt, that normally the puerperium passes without fever. In the past it was an established belief that the puerpera during the first few days, especially when the secretion of milk began, must have fever. This idea was rendered more plausible by the fact that not a few women, especially primiparæ, undergo no little emotional excitement. The pain which accompanies the secretion of milk, some difficulty in coaxing the child to nurse, the soreness experienced when it seizes the nipples, all tend to excite and worry the mother, especially if she be a primipara. The physician or nurse finds the pulse quickened, the face red, and the patient complaining of exhaustion, and, possibly, of severe headache. Surely under these circumstances it was not unreasonable to say that fever was present. The clinical thermometer, however, has upset entirely this opinion.

There is No Such Thing as Milk Fever. The secretion of milk of itself, be the breast ever so hard or swollen, goes on in innumerable cases without a rise of temperature. Careful observation has also proved that retention of milk does not cause fever. Elevations of temperature may be caused by trifling circumstances, but if the rise is not very slight and quite transient we are in face of some pathological factor. Zweifel holds that a temperature of 37.6° C. or 37.7° C., 99.5°–100° F., in the axilla is always pathological. *If the puerpera has not been subjected to harmful influences she will have no fever. Milk fever is traumatic fever, and traumatic fever means infection.*

It is hardly possible to repeat this fact too often, for if it is neglected valuable time may be wasted in vain hopes, when a rigid search might reveal the pathological cause and enable us at once to institute measures to rectify the conditon.

The Pulse. After completion of the third stage the pulse usually decreases very markedly in rapidity. The first sound of the heart often takes on a soft murmurish tone. This change may not occur at once, but usually takes place within the first twelve hours, the rate falling to 60 or less, and in exceptional instances to 40 per minute. A pulse as low as 34 has been recorded. The arterial tension is not increased. The duration of this slowing of the heart varies in individual cases, being usually in direct proportion to the lowness of the rate. No completely satisfactory explanation of this phenomenon has been arrived at. Doubtless the complete physical and mental rest, coming as it does after a period of anxiety and suffering, plays an important part, although it does not by any means of itself afford a sufficient explanation. Olshausen thought that the absorption of fat and the presence of fat emboli could account for the slowing of the pulse. It is possible that the stasis occurring in the abdominal veins may account in part for the slowing of the circulation, or that the shutting off of a great mass of blood going to the uterus, by relieving the heart of some of its work, may act in the same way. Both these theories, however, are rendered somewhat unsatisfactory from the fact that the slowing of the pulse also occurs after early abortions, in which the shutting off of the utero-placental circulation or stasis in the abdominal veins could hardly figure as relieving the heart of much extra work. The same objection applies to the attempt to find an explanation in the increase of the pulmonary capacity as a consequence of the expulsion of a large abdominal tumor. It is only natural that the rate and character of the pulse of the puerpera may be temporarily influenced by very trifling causes.

The Respiration. At one time it was held that the pulmonary capacity was increased after labor. Modern investigations, however, do not bear out this assumption. Out of 50 cases examined by Vagas the pulmonary capacity was found to be the same as before labor in 26 cases. It was increased in 17 and decreased in 7 cases. The character of the respirations is not markedly altered.

The Skin. Formerly the "puerperal sweats" were well known. They were noted especially during sleep and often attended by what was thought to be a characteristic odor, which was probably dependent upon the presence of fatty acids, and often accompanies severe sweating. The older obstetricians welcomed their appearance and regarded their absence as a somewhat ominous sign. At the present day, now that the close, overheated lying-in chamber has given place to the cool, well-ventilated room, one rarely sees drops of sweat upon the forehead of the puerperal woman.

The skin of the abdomen shows shining whitish or reddish lines, which at a later date become quite white, the lineæ albicantes. These are usually arranged in the form of crescents running from the groin toward the umbilicus, and are far more numerous and more deeply marked below the navel than above it. They are caused by overstretching of the skin during pregnancy and the subsequent replacement of part of the corium by scar tissue. Areas of pigmentation which have appeared on the face, abdomen, around the nipples, and elsewhere on the body during pregnancy, gradually begin to fade during the puerperium, although, as a rule, they do not entirely disappear. The areolæ of pigmentation around the nipples, more marked in brunettes, grow less conspicuous, but are never entirely obliterated.

The Digestive Apparatus. Just as the excretions of one organ serve to nourish other organs, it is not improbable that a considerable amount of the products of the involution going on in the genitalia is utilized as food for the other tissues of the body; but that all are not so used is proved by the fact that peptone can be demonstrated in the urine. The power of the digestion of solid food is for a time enfeebled. Thirst is usually present, and is easily accounted for by the great drain of water from the body in the increased perspiration, the lochia, the milk, and the urinary secretion. The sluggishness of the bowels has already been referred to.

Loss in Weight. As elimination exceeds ingestion, it is self-evident that the puerperal woman must lose considerably in weight. The amount lost has been variously estimated as from one-twelfth to one-eighth of the entire body-weight in the first seven days. Non-nursing women and primiparæ lose less than nursing mothers and multiparæ, the loss being actually, though not relatively, greater in proportion to the normal body weight. Under ordinary circumstances the diminution should cease at the latest by the ninth day.

Lactation. The breasts for a short time after labor afford a secretion similar to that which they contained during pregnancy. This early milk, or, as it is called, "colostrum," is a whitish or faint yellowish, viscid fluid resembling milk, but differs from it chemically in being richer in sugar, fat, and salts. It seems to have a laxative effect upon the child, and sweeps away the meconium from the bowels. This action has been attributed to the separate or collective effect of the excess of the several ingredients. One author advances the view that it acts by its indigestibility. Microscopically it differs from milk in containing the so-called "colostrum" cell, which is nothing more nor less than a large epithelial cell studded with fat globules. The fat globules of the colostrum are not as uniform in size as those of milk.

The true milk secretion begins about the second day or occasionally on the third day. The breasts, which have already enlarged during pregnancy, become still more tense and swell to such a degree that they are often very sensitive, and may be the seat of considerable pain. The pain and emotional disturbance, especially if there is trouble in making the infant take the breast, may give rise to a slight elevation of temperature. The so-called milk fever, a myth of the prebacterial stage of medical knowledge, has been discussed. Microscopically, human milk is seen to consist of minute oil globules of rather uniform size, floating in a transparent, colorless plasma. Human milk, like that of all other animals, is an emulsion. The emulsifying agent is an albuminoid, the casein. The plasma contains milk-sugar and inorganic salts. The fats, sugar, and casein are produced from the cells of the acini of the glands. The liquid portion, the plasma, is obtained from the blood. As regards its chemical constitution, milk varies in different women or at different times, and even in the two breasts of the same woman. The approximate chemical composition of rich human milk is shown in the following table:

Water	88.9 per cent.
Solids	11.1 "
Casein	3.82 "
Fat	2.66 "
Milk-sugar	4.36 "
Inorganic salts	0.14 "

The quantity of milk secreted varies also in different women and at different times. During the first three days the whole amount may be between 50 and 200 cc., but the quantity rises rapidly, until by the ninth day 400 to 450 cc. are being secreted daily. The character of the milk is altered by various conditions of the mother. Certain medicines when given the mother are given off almost unchanged in the milk secretion, and may seriously disagree with the nursing child. It has been found also that mental or physical disturbance in the mother may so alter her milk so as to render it unwholesome. The reappearance of the menstrual function makes a change in the character of the milk. The disturbance, however, is usually temporary, and subsides immediately after the menstrual period.

In women who do not suckle their children milk secretion goes on for a couple of days; during this time the colostrum corpuscles gradually decrease, but again show a relative increase. The breast undergoes a physiological atrophy; the secretion gradually becomes less, until at the end of from fourteen to sixteen days it practically ceases.

The period of lactation may be said to last for almost one year, though at the end of the sixth or eighth month the quantity and quality of the milk secreted often begin to fall off. Some women nurse their children far into the second year, but the nutritive properties of the milk are of necessity very poor.

CARE OF THE PUERPERAL WOMAN.

Remembering that the puerperium after a properly conducted labor is a natural condition, it remains for the obstetrician, while abstaining strenuously from meddlesome interference with nature, to take such precautions as shall prevent the physiological from merging into the pathological upon which it so nearly borders in these cases. The main treatment may conveniently be discussed under three heads: (1) proper nutrition; (2) absolute rest of body and mind; (3) proper hygiene with aseptic treatment of the wounded parts.

Nourishment. Liquids should be given for the first two or three days. Milk is the best food, but an occasional cup of beef-tea, clear soup, or weak cocoa is often very grateful to the patient. For thirst, water must be principally given, but a cup of tea, if the patient expresses a desire for it, will do no harm. After the third day a gradual return to the usual diet may be made. After the first week extra nourishment, preferably in the shape of milk between meals, should be allowed. Malt liquors or wines are usually unnecessary; if, however, the woman is habituated to a moderate use of them they may be allowed in very small quantities. The patient's own tastes may be consulted and will usually serve as a guide for the diet to be given, provided nothing too heavy or manifestly indigestible be desired. If the patient is fond of eggs they form a very nourishing food, and can be given to her prepared in a number of different appetizing forms.

Rest. The puerpera should have complete bodily and, what is just as important, absolute mental rest. After remaining quiet for a few minutes after the completion of the third stage of labor, the mother usually desires to see her child. This wish may generally be gratified; but as soon as possible after the linen has been changed and she has been made comfortable the room should be moderately darkened and the patient should be left to sleep. After she awakes the infant may be put to the breast for a few minutes. For the first two or three days the woman should be kept flat on her back, with the head only a little raised on a small pillow. When nursing the infant she may assume the lateral position, if this is found to be more convenient, but all sudden changes of position, especially the sudden arising into a sitting or standing posture, for the first few days must be strenuously avoided. Neglect of such precautions has not infrequently been followed by fatal syncope. After the uterus has had time to contract firmly and the sinuses have been permanently closed, the danger becomes minimized; but it is, nevertheless, advisable to avoid any sudden change of posture for some time. It is well to secure greater safety, even at the expense of a little discomfort, and for the first few days not to allow her to rise even to pass urine or to have a movement from the bowels; for this purpose she should be induced to use the bed-pan. It is not uncommon for patients to experience considerable difficulty in passing the urine while in the recumbent position; this, however, may generally be obviated by applying a warm wet aseptic compress to the vulva. Occasionally the sound of a little water trickling into the bed-pan will have a salutary effect. If no urine has been passed for over eight hours, and the various simple expedients have failed to cause the patient to urinate voluntarily, she will have to be catheterized.

Glass catheters are cheap, and if broken can readily be replaced. They are better than those of other material, since they can easily and certainly be kept aseptic. Before and after use they should be thoroughly cleansed with hot water, and in the intervals may be kept in 1:40 carbolic-acid solution. Before being used the catheter is rinsed thoroughly in sterilized water in order to free it from the carbolic acid. Catheterization demands complete exposure of the parts, and as thorough asepsis as possible. Without the former the latter is impossible, and catheterization under the bedclothes is inadmissible. A little tact will generally suffice to overcome the objections of any patient who has been accustomed to the old method and who may feel a little sensitive about the procedure. The external genitals, more particularly the parts immediately around the meatus, should be cleansed from lochia and the labia be held apart while the catheter is being introduced. These precautions are necessary every time catheterization is employed if we wish to provide against the chances of setting up what may probably be a serious cystitis. When it has been found necessary to draw off the urine the catheter should be used once, and as soon as the bladder begins again to be moderately distended the patient should be urged to make several efforts at emptying the bladder spontaneously. If she is unsuccessful in her attempts she should not be allowed to go more than eight hours without having her bladder emptied. In a few cases repeated catheterization will be forced upon us, but we should not fail to do our utmost to obviate the necessity as soon as possible.

The bowels should be opened by the third day. This is best accomplished, if it does not occur spontaneously, by some simple enema, preferably of soap and water. Should this prove ineffectual, and large masses of feces be present in the rectum, three or four ounces of sweet oil may be injected carefully and allowed to remain for half an hour, after which another simple enema may be given. A dose of castor oil, given in capsules if preferred, will generally aid very much in bringing about a satisfactory result. Care should be exercised in giving medicines to the nursing woman, since many drugs, notably the minerals and rhubarb, are excreted partially in the milk secretion, and may thus disturb the digestion of the child. Salts are not recommended in these cases, because they are supposed to diminish the secretion of milk; in many instances, however, especially when there is abundance of milk, they seem to act well.

Perfect mental rest is of the greatest importance to the puerperal woman. A short nap will do more to strengthen and invigorate her than any amount of congratulations on the part of relatives and friends. With the exception of the husband or mother, who may be allowed to remain if their presence seems to quiet and comfort the patient and does not interfere with her rest and sleep, all other visitors should be rigorously excluded. The child should not be kept near enough to disturb her by its cries, and should under no circumstance be allowed to sleep in the same bed with its mother. If this rule were always carried out the rate of mortality from "overlying" would be considerably diminished. Until she has regained her strength the patient should be kept free from all household cares. These should be delegated to the nurse or some other competent person. The anxieties and troubles of others should not be brought to her for sympathy. Excessive joy or grief has not infrequently caused death in puerperal women. Mental emotion has been known to bring about inhibition of the contractions of the uterus, and thus to cause dangerous flooding, and even if it does not produce serious symptoms, excitement always interferes with the proper progress of convalescence.

The Lying-in Room, whenever it is possible, should be in some quiet part of the house as far removed as possible from the noise of the household and street. It should be well lighted and airy, but should be so arranged that it can be shaded when necessary, since a partially darkened room is more productive of rest and sleep. The light should never strike directly into the patient's eyes, and there should be no perceptible draughts. Ventilation should be so arranged that no one on entering should be able to detect any odor. The temperature should be kept steadily between 60° and 70° F. No noise or disturbance should be permitted. At no time must the lying-in room be made a general meeting place for a large circle of relatives and friends. The woman's linen and the bed should be kept scrupulously clean. Frequent changes of the napkins and bed linen should be made. This can be done readily, without disturbing the patient, by making use of draw sheets.

After-pains. In primiparæ, as has been said, the after-pains are rarely severe enough to demand interference. In multiparæ, on the other hand, they may be very annoying and may seriously discommode the patient, interfering with sleep and rendering her miserable. Under such circumstances some treatment must be instituted. The physician should never consider any discomfort of his patient as too trivial for his serious attention, and although at times he may not think it wise to have recourse to drugs for her relief, he will not hesitate to employ them whenever the situation demands it. Opium or its alkaloid, morphine, relieves pains more effectually than any other drug in the *Pharmacopœia*, but is not always well tolerated. Chloral alone, even in comparatively large doses of 15 or 30 grains, is not very efficacious in relieving pain, although its effect is quieting. Some such combination as the following generally acts very well:

Morphinæ sulphatis	gr. $\frac{1}{6}$–$\frac{1}{4}$
Chloral hydrate	gr. 10–20

Bromides are practically worthless against acute pain. They act slowly and very feebly. Antipyrine, antifebrine or acetanilid, and phenacetin have considerable analgesic action and are occasionally of service. Their use should, however, in no case be prolonged, as they are all depressants and are said to interfere with involution. Should opium be given it is necessary to keep its constipating action in mind and be governed accordingly.

Care of the Genitalia. If the labor has been normal and no instruments have been used, and no incautious or too frequent vaginal examinations have been made, it is safe to assume that the condition of the genitalia is physiological, and consequently demands only rigid asepsis to keep it so. No vaginal douches are necessary after the completion of the third stage. The vulva should be washed off with a stream of sterilized water, its action being aided by gentle friction with sterilized fingers or pledgets of sterilized cotton held in the forceps, and should then be protected by a generous dressing of sterilized cotton or gauze. The dressings should be changed every hour or two for the first six or eight hours, and during the next day every three hours. After this they should be changed three or more times daily, according to the amount of soiling. When the dressings are removed the external genitals should be cleansed of lochia, and should then be washed with an antiseptic solution, which in turn should be removed with sterilized water. For this purpose under ordinary circumstances a saturated solution of boric acid acts best. A 1 to 2000 or 3000 solution of bichloride might be used, provided one could be sure that none of it was allowed to enter the vagina. In view of the fact that considerable danger of mercurial poisoning exists, it is better to make use of some less toxic antiseptic. A 2 per cent. or a 1 per cent. solution of creolin may be employed, but the odor may render its use disagreeable to the patient. Should the discharge become fetid, antiseptic douches may be called for. Bichloride of mercury and carbolic acid are dangerous in the condition in which the vagina and uterus are at this time, but may be employed with caution in weak solutions and when carefully controlled by the physician. A 1 per cent. solution of lysol, a 2 per cent. solution of creolin, hydrogen peroxide in full strength, diluted chlorine water, and permanganate of potash in weak solutions have their advocates. Should the woman show evidences of infection the case ceases to be physiological and becomes pathological. The proper course to be pursued under such circumstances will be found in the section on the Pathology of the Puerperium.

Nursing the Child. Four or six hours after labor, after the mother has been refreshed by a good sleep, the child may be put to the breast for a few minutes, and then for two or three days, until the secretion of milk is established, at intervals of four hours, after which it should be nursed every two hours from 6 A.M. to 10 P.M. In this way the child receives nourishment nine times in the twenty-four hours, and the mother can obtain seven hours or more of uninterrupted sleep. Occasionally one nursing at night is necessary. Without regularity in nursing it is hardly possible for either mother or child to do well, and many cases of severe debility and anæmia in nursing women are due mainly to over-frequency in nursing, while the stomach of the child, from want of rest and improper quality of the milk, is also seriously disturbed. The nipples should be gently cleansed after and before each nursing with a saturated solution of boric acid, and should then be dried by patting with some soft absorbent material. No rubbing should be employed. Should the nipples tend to become sore or cracked, inunction with a little cacao-butter, after each nursing and cleansing, may do valuable service by protecting them from the air and by softening and rendering the skin more pliable. The mother may, perhaps, be unwilling to suckle the child, but when no contraindication exists she should be persuaded to do so for her own sake and for the child's welfare. The act of suckling promotes involution in the genitalia through reflex nervous action, and thus the mother is benefited. For the infant no food is so suitable as its mother's milk, and thus the child is benefited. There are, however, certain conditions in which nursing the infant may be impossible or inadvisable. In cases in which the mother's health is very feeble lactation might be too serious a drain upon her. Under such circumstances it will be better for the infant, too, to prohibit suckling, as the mother's milk will almost certainly be defective in quality or quantity, and probably in both. A tuberculous mother, even when comparatively strong, should not suckle her child, for fear that she might infect the infant. This same rule applies also to cases in which the woman has contracted syphilis late in pregnancy, since it is just possible that the child may not be syphilitic. If, however, the disease was inoculated previous to or at the time of conception the child should be suckled by its mother, unless other contraindications exist. It is not right to subject a non-syphilitic wet-nurse to the risk of infection by allowing her to suckle the infant of a syphilitic mother, even should all signs of syphilis in the child be lacking. The condition of the breasts may contraindicate nursing the child; inversion of the nipples, cracked nipples, mastitis, or defective secretion may render suckling impossible or inadvisable. Defect in the quality or quantity of the breast-milk will quickly make itself apparent by the fact that the child does not thrive or gain in weight as it should, even if it shows no signs of serious digestive disturbance. Moderate "over-feeding" of the mother, combined with general tonic and supporting treatment and proper hygienic measures, will often rectify this faulty condition. It is, of course, necessary to see that the over-feeding does not go far enough to injure the woman's digestion. The exhibition of drugs, of which there is so long a list under the heading of galactagogues, rarely, if ever, does any good. In many cases the use of them undoubtedly does harm. Strychnine, iron, and quinine in tonic doses are frequently beneficial. It is well to order a certain amount of milk at intervals during the day; if taken between meals it often agrees better. Malt liquors or extract of malt in moderate doses suits some patients. Somatose is believed to be useful. Thyroid extract, gr. j, three to five times daily, is said to improve the quantity and the quality of the milk. Inversion or retraction of the nipples should, as far as possible, have been rectified during the later months of pregnancy. Cracked or fissured nipples should be kept scrupulously clean, washed frequently with a saturated solution of boric acid, and anointed with cacao-butter over which a protective film of the compound tincture of benzoin may be applied. A well-fitting nipple-shield is often a great comfort when the act of suckling irritates the nipples. In the more severe cases the breasts may be drawn by means of a breast-pump and the milk given to the child with a spoon or medicine-dropper. Mastitis or mammary abscess generally renders the milk unfit food for the infant. Should the breasts become painful from over-distention, or should their increased weight produce irritation or disagreeable sensations, a compressing or supporting bandage may be applied. A wide roller-bandage properly applied will answer the purpose as well as a specially made breast-binder when the latter cannot be procured. Saline cathartics and moderation in the use of liquids will aid in diminishing over-distention from profuse secretion. Where the child is puny and does not draw enough milk to relieve the gland, the breast-pump may be made use of.

When for any reason it is proper that lactation be brought to an end during the puerperium, the application of a proper bandage to the breasts and moderation in the use of liquids generally answer every purpose. The woman will probably experience some pain in the breasts for several days, but this under ordinary circumstances soon subsides and the glands undergo involution. Occasionally it may be necessary to give saline cathartics. Atropine and iodide of potassium are strongly recommended by various authors. Of the latter 5 to 15 grains may be given in water, carbonated water, or milk three times a day. Hirt prefers to give this drug in hot milk. The syrup of sarsaparilla, in which it is so frequently given, adds in no way to its efficacy, and the combination makes a nauseous mixture, which, strange to say, however, is not disagreeable to many patients.

The Visits of the Physician. The physician after the completion of labor should always remain within call until the uterus has firmly contracted and all immediate danger of hemorrhage has passed. He should see that the patient is as comfortable as possible, and so order arrangements that she will get the necessary quiet and refreshing sleep. The child's condition should have been examined into, and any defects in formation should have been noted. The umbilical cord should be inspected to make sure that it is in order and that the ligature has not slipped. Just before leaving the physician should give clear and distinct orders to the nurse in charge concerning the management of the woman and child. These may be put in writing if thought advisable. A visit should be made within twelve hours after labor, and at that time both mother and child should be examined carefully to see that all is going well. The physician himself should note the temperature, pulse, and respiration, keeping in mind the ease with which injurious distention of the bladder can occur and the fact that the passing of urine is often reported with a too full bladder and may simply mean an overflow (enuresis paradoxa). The state of the skin, the digestive apparatus, the amount and character of the food, the condition of the uterus and the lochia, must all be inquired into. The woman must not be allowed to become constipated. After the third day she should have a daily bowel passage. The condition and welfare of the child must not be forgotten. Inquiries must be made as to whether it has been fed or suckled, whether it is thriving and gaining weight or not, and about the conditions of its various functions. The nurse should be directed to keep for the reference of the physician a record of temperature, pulse, and respiration, of the bowel passages of both mother and child, and of the number of feedings of the child. Anything else which she may deem of importance for the treatment of the case should be duly reported. Temperature, pulse, and respiration should be taken three times a day for the first week; after that twice a day suffices. For the first week the physician should make a daily visit, after which time, providing the nurse be competent to care for the case properly, it will be sufficient to see the patient every second or third day. The patient should not be allowed to get up until the change is sanctioned by express order of the physician, and she must continue under his observation until convalescence is fully established.

Tardy Involution. When the progress of involution is abnormally slow it may be promoted by the use of friction, faradism, or small doses of ergot. Hot vaginal douching is useful, but this is a matter which can seldom be trusted to the nurse.

Friction is applied to the uterus by the nurse in the same manner as in the third stage of labor. The hand, laid flat on the abdomen, moves the abdominal wall with it in a circular direction over the anterior surface of the uterus. The treatment is continued for ten or fifteen minutes twice daily.

Faradism may be applied through the uterus from side to side, the electrodes resting on the abdomen, or one on the abdomen over the uterus, and the other over the upper sacral region. The current need not be strong enough to cause pain.

Ergot in doses of ten or twenty minims three times daily is frequently of service.

A hot vaginal injection at a temperature of 48.8° C., 120° F. and repeated twice daily is effective. Douches, however, should, as a rule, be administered only by the physician and with extreme aseptic precautions.

A frequent cause of tardy involution, and which may pass unsuspected, is a mild infection of the endometrium. In such cases curetting is generally required. Curetting on this indication alone is seldom advisable earlier than the third or fourth week of the puerperium.

Displacement of the Uterus. The uterus sometimes becomes retroverted or retroflexed in the latter part of the puerperal month. This is most frequently the case in subinvolution, and particularly when retrodisplacement had existed before pregnancy. Evidence of the malposition will usually be afforded by pelvic tenesmus, by pain in the sacral region, and by return of the bloody flow. These symptoms are most marked on getting up. If on vaginal examination the diagnosis is confirmed, the uterus should immediately be replaced manually and supported by a suitable hard-rubber pessary. The pessary must be worn for two or three months. By the timely adoption of this treatment a permanent retroversion may almost invariably be prevented.

Pelvic Examination. It should be a routine practice to make a bimanual examination of the pelvic organs in the third or fourth week of the puerperium. The object is to determine the presence or absence of injuries of the vagina or cervix, the degree of uterine involution, and the possible existence of retrodisplacement of the uterus or other abnormal conditions.

THE DIAGNOSIS OF THE PUERPERAL STATE.

It is sometimes important for medico-legal or other reasons to determine whether or not a woman has been recently pregnant, or whether an abortion or labor at full term has lately taken place. In such cases the patient herself may be dead or, if living, may for various reasons deny absolutely the imputation of pregnancy, so that it will be left to the physician to determine from objective signs the true condition of affairs. Since the decision may involve serious consequences to one person or more, it is especially important not only that the report of the physician should be accurate, but that he may be able to bring forward proof which in the eyes of skilled witnesses may be considered irrefutable.

The evidences of a recent delivery may be divided into three classes: (1) positive, (2) probable, and (3) uncertain.

The Positive Signs of the puerperal state are derived from the ovum, and are only to be recognized by means of the microscope. The demonstration of placental tissue, especially chorionic villi, in a scraping or in a section taken from the uterus, is proof positive that the woman has been pregnant within a reasonably recent period.

The Probable Signs are numerous. The finding under the microscope of the so-called decidual cells, the much-enlarged cells of the uterine mucosa or decidua, is not absolutely conclusive, since very similar cells are found in certain cases of endometritis. Nevertheless the occurrence of these large cells, when found in conjunction with other probable signs, affords strongly presumptive evidence of a pregnancy. The same may be said of the abdominal striæ or lineæ albicantes, the contused condition of the genitalia, the presence of secretions resembling the lochia, the dilated smooth vagina, the soft and lacerated cervix, the enlarged uterus, and the swollen breasts with their well-marked areolæ and their secretion of colostrum or milk. These signs taken singly are not positive, since the occurrence of any one alone, or of several of them together, may be due to conditions other than pregnancy. The enlarged uterus, the softened and more or less lacerated cervix, the abdominal striæ, and at times even the milk-secreting breasts may all have had their origin in the previous presence and delivery of a large submucous uterine fibroid. It is only when a number of them are present at one and the same time that the proof of a preceding pregnancy may be said to be established beyond reasonable doubt.

The Uncertain Signs include the relaxed wrinkled condition of the abdominal walls, venous varices of the lower extremities, profuse sweats, and other less important symptoms. Such conditions are, of course, met with also in men as well as in women who are not pregnant. The relaxed, withered appearance of the abdominal walls may be due to the absorption or rapid disappearance of a large amount of fluid from a previous ascites or a large ovarian cyst. Mottled areas resembling the true striæ albicantes occur in people who have previously been stout and have subsequently lost flesh, and are due, as in the puerperal state, to the removal of the distention. Signs of this class, therefore, can only be regarded as affording confirmatory evidence of a condition indicated by those of the other categories. As regards the time that has elapsed since delivery, the condition of the lochia, of the vaginal wounds and the breast function must be taken into consideration. It must be remembered that placental and chorionic villi may be found in the uterus months after delivery has taken place. Our decision, therefore, on this point can never be more than approximate.

CHAPTER XI.

THE NEW-BORN CHILD AND ITS MANAGEMENT.

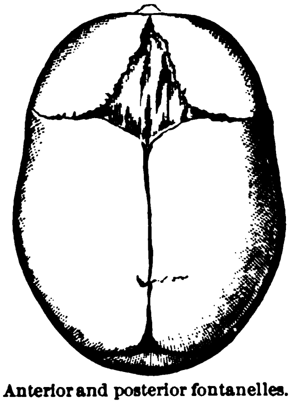
ANATOMY AND PHYSIOLOGY.

BEFORE considering the management of the new-born infant, it may be well to recall some of the more important points in the anatomy of early infancy.

It may be stated in general that the thoracic and abdominal viscera of the infant are relatively more highly developed than the brain and generative apparatus. The bones are soft and flexible, from the excess of animal matter and deficiency of calcium phosphate, The muscular structures are poorly developed, while the circulatory and lymphatic systems are relatively large.

The Cranium. The cranial vault at birth is more or less plastic, owing to the fact that its bones are not fully ossified nor firmly united. The base of the skull is more unyielding than the frontal and parietal portions. The posterior fontanelle is usually nearly closed at birth, while the anterior generally remains widely open. (Fig. 209.) The closure of the anterior fontanelle at birth, or soon after, is abnormal, and may indicate that the brain is abnormally small. When it is abnormally large it indicates a lack of development of the bones.

FIG. 209.



Anterior and posterior fontanelles.

As the jaw is rudimentary, and the teeth absent, the facial part of the skull is relatively small.

The Spinal Column is straight at birth, but marked by great flexibility. The usual adult curvatures in the dorsal and sacro-coccygeal regions are but little developed in early infancy. The development and co-ordinating powers of the spinal muscles are feeble. It is usually several weeks before the infant can hold its head erect.

The Nervous System is imperfectly developed at birth. Although the brain is large, it is soft and presents no sharp distinction between the gray and white matter. The spinal cord is relatively in a higher stage of growth than the brain, especially the anterior horns. The posterior and sensory portions of the cord are more immature. This explains the fact that motor manifestations are so active at this time, as sensory irritations and disturbances are quickly reflected into the predominant motor area. The rapid and irregular character of the muscular movements is evidence of this physiological fact. No act of volition takes place in the new-born, all movements at this period being automatic or reflex. Reflexes can be obtained after birth not only from the cutaneous nerves of the surface, but from the nerves of special sense—the optic, olfactory, and auditory.

Special Senses. The pupils of the eye may be unequal in size, but they react to light. The perception of light by the new-born is, however, imperfect, and the sense of sight, other than the ability to distinguish light from darkness, is not developed. Hearing is also imperfect, as the cavity of the tympanum is apt to be filled with fluid and the tympanic membrane is placed in a horizontal position. The senses of taste and smell are feebly developed at this time. The size of the peripheral nerves is relatively large, but their function is not active during the first few days after birth.

The Thorax. The thorax is of small size in the new-born, the circumference being a little less than that of the head. The cavity is shallow in its antero-posterior diameter, the distance from the vertebral column to the manubrium being so small that compression may be induced by enlarged lymph-glands. There is a widening out, relatively great, toward the base of the cavity. The ribs are soft and elastic, being inserted in a rectangular and horizontal direction, which renders the respiration almost entirely abdominal. The intercostal muscles are thin and they exert little action on the ribs. The first dorsal vertebra is on a level with the upper margin of the sternum at birth, but later the second dorsal vertebra assumes this position.

The Lungs. Just before birth the unaerated lungs lie in the posterior part of the thorax on either side of the pericardium. Immediately on delivery several deep and spasmodic inspirations should quickly inflate the lungs, which then assume a pinkish color. For the first few weeks the respirations are irregular in character, and they vary in frequency from 35 to 50 per minute. At times a pause of a few seconds between inspiration and expiration may be noted. The active growth and development of the infant results in the production of double the amount of carbon dioxide in proportion to its weight that is normal in later life. Hence the importance and stress of work that falls upon the lungs, which are smaller in proportion to the weight of the body than in the adult. The rapidity and tumultuous character of the respiration common in early infancy are thus explained.

The Heart. The heart in the new-born is relatively wide, from the development of the right side, which has been functionally active during intra-uterine life. As a consequence, the apex-beat reaches to the mammillary line, and sometimes outside of it. A glance at the changes taking place in the circulation at birth will explain certain cardiac anomalies of early infancy. The blood from the placenta, after passing through the liver, with the exception of a small portion passing through the ductus venosus, joins with the blood returned from the lower extremities by the inferior vena cava. This is delivered into the right auricle, and passes through an opening, the foramen ovale, guided by the Eustachian valve, into the left auricle. It passes directly from the left auricle into the left ventricle, and thence into the aorta. The blood in the aorta is distributed principally to the head and arms, although a small portion may be carried by the descending aorta to the lower extremities. This explains the unequal development of the upper and lower extremities of the fœtus. The return circulation from the head and upper extremities is collected by the superior vena cava, which empties into the right auricle, mixing with a little blood from the inferior vena cava. It passes over the Eustachian valve from the right auricle into the right ventricle, and thence into the pulmonary artery. Very little blood passes from the pulmonary artery to the lungs in the fœtus, as these organs are solid and nearly impervious; the great mass of this blood passes through the canal of the ductus arteriosus into the descending aorta, where some is distributed to the lower extremities and abdominal viscera, but most of it is carried to the placenta by means of the umbilical arteries. The relatively large development of the head and upper extremities at birth is explained by the fact that the fresh blood from the placenta passes first to these parts, as explained above, while the blood reaching the lower extremities by the descending aorta has already circulated through the upper part of the body. At birth, with the interruption of the placental circulation, the lungs should immediately inflate and draw off a large supply of blood through the pulmonary arteries. The foramen ovale gradually closes, and the opening should be completely occluded by the tenth day. At times this process is not complete, and a small valvular opening remains between the auricles. As soon as respiration begins, the ductus arteriosus commences to contract, and the occlusion should be complete from the fourth to the tenth day. The size of the heart in the new-born is large as compared with the rest of the body. According to Gray, this ratio is as 1 to 120 at birth, while in the adult the average is about 1 to 160. The arteries are also relatively wide in comparison with those of the adult, and the arterial pressure is small in young infants. The heart acts quickly and somewhat irregularly in the new-born, the pulse-rate varying from 125 to 140 or 150.

The Blood. Upon ligation of the umbilical cord and the cessation of the placental circulation, important changes follow, not only in the infant's circulation but also in the blood itself.

These changes appear to be first of a degenerative nature, and they are consequent upon a more perfect oxygenation of the blood. Immediately after birth the red corpuscles number six or seven millions per cubic centimetre, while by the fourth or fifth day the number has dropped to four or five millions. The size of the red corpuscles at birth is likewise variable, and the white corpuscles are present in much greater proportion than in the blood of the adult. The amount of blood in the new-born is less in proportion to the body-weight than in older subjects. The quantity of blood immediately after birth will vary somewhat according to the length of time during which connection with the placenta is maintained. Just after birth, there is comparatively little fibrin in the blood, hence a certain slowness of coagulation. Cephalhæmatomata are slow in solidifying, and meningeal apoplexies are apt to spread over the surface of the brain as a result of this condition of the blood. Its specific gravity is also somewhat lower than in later years.

The Digestive Organs. A peculiarity of the mucous membrane of the mouth in the new-born consists in its thinness and the frequent existence of minute patches of epithelium on the median line of the palate, the so-called "epithelial pearls."

The Stomach. The stomach is small, with more of a vertical than a horizontal inclination, the fundus being absent. It is little more than a simple dilatation of the intestinal tube, and will hold without distention only about an ounce of fluid. Vomiting easily ensues by a sort of regurgitation, without nausea, when overfilling takes place, by simple contraction of the walls of the tube.

The Intestines. The small intestine is not uniform in its length at birth, but measures, on an average, a little more than nine feet. The large intestine measures not quite two feet, and is distinguished in the new-born by the greater relative length of the lower part of the colon.

The Liver. The liver at birth is of relatively large size, being greater in bulk than both lungs, and containing much blood. The large size and importance of the liver in fœtal life will be understood by considering it a sort of intermediary organ between the placenta and the general circulation, as far as the re-oxygenated blood is concerned. At birth the communication between the placenta and the liver and portal vein, by means of the umbilical vein, is severed by cutting the cord. The lungs at once inflate and assume the respiratory function. The umbilical vein begins to shrink, and is completely obliterated between the second and fifth days of life. It is finally reduced to the fibrous cord known as the round ligament of the liver. The ductus venosus is usually obliterated within a few days after birth. Although the liver has now lost its preponderating importance in the economy, it still remains relatively larger and heavier than in later life. The diminution of the organ is due to its altered blood-supply, and is especially marked in the left lobe. The loss of weight that begins at birth continues from infancy to old age.

The digestive juices are imperfectly secreted in the new-born. Saliva is present in some degree with slight proteolytic power; the gastric juice is fairly active, but the pancreatic secretion does not attain physiological potency for several months. The intestinal glands are likewise in a low stage of development. The bile is poor in cholesterin, lecithin, fat, the special bile acids, and in inorganic salts. It is, hence, not difficult to understand the feeble digestive powers of early infancy, and the necessity for the greatest care in the administration of nutriment.

The Urinary Organs. The pelvis is shallow; its inclination is exaggerated, and its capacity is small. The bladder is largely an abdominal organ.

The Kidneys. The kidneys are embedded in loose, fatty tissue, low down in the abdominal cavity, covered only in front and on their external borders by peritoneum. They are relatively of large size, and are distinctly lobulated. Crystals of uric acid often form in the calyces and in the pyramidal portions of the kidney during the first few days of life, and may produce considerable disturbance by their presence. The suprarenal capsules are also of large size, sometimes completely covering the kidneys.

The Bladder. The bladder when distended is oval or egg-shaped in form, without a marked fundus, and it lies principally in the abdomen. The muscular wall is relatively very thick and dense, so that in female infants the bladder may be mistaken for the uterus on autopsy. In the female the urethra is placed along the anterior wall of the vagina, and its meatus appears almost as large as the orifice of the vagina. Confusion is sometimes encountered in passing a catheter unless this fact is borne in mind. Urination may take place at birth or a few hours after, when the fluid is clear and light colored, or it may be delayed for twenty-four hours, when its appearance is apt to be deep yellow and turbid. Sometimes when the urine is surcharged with uric acid and the urates, yellowish or red deposits are left upon the napkin, which the attendant may mistake for blood. The daily amount of urine is scanty during the first three days, or before the free secretion of milk; it increases very rapidly during the next few days. Its average specific gravity is from 1005 to 1010.

The Skin. The skin of the new-born infant is soft and red, and covered with very fine hairs called lanugo, which are shed during the first few weeks. The sebaceous are more active than the perspiratory glands. Immediately after birth, the whole surface of the body is covered with sebum, with which are mixed epithelial cells and lanugo.

The Lymphatics. The lymphatics are abundant and large in size in young infants, having a very free communication with all parts of the body.

Growth. The infant loses in weight during the first two or three days following birth, but after this there should be a steady increase in growth. According to Dr. Money, after the fourth day the body gains in weight at the rate of three ounces for the second week, four ounces for the third, five ounces for the fourth, and during the second month an ounce a day is about the proper rate of increase. The average weight at birth, of well-developed infants, varies from seven to eight pounds. The muscles, which are feebly developed in the new-born child, increase rapidly in size and strength. The average length of the male infant at birth is about 50 centimetres, and of the female, about 49 centimetres.

MANAGEMENT.

Respiration. The first duty of the attendant, after the delivery, is to see that respiration is established. The mouth should quickly be cleansed of mucus or blood, and the infant placed on its back or right side. If it does not breathe at once, respiratory efforts may be provoked by such simple measures as blowing on its face, a few smart taps with the hand upon the buttocks, or sprinkling with cold water. If the child draws three breaths during the first minute, it may usually be left to itself. Should it still fail to breathe, examination is made to see if the heart is pulsating. If it is, the cord is severed and artificial respiration maintained as long as the cardiac pulsations can be felt or until regular spontaneous respirations are established. For the methods of performing artificial respiration, the reader is referred to the Treatment of Asphyxia of the New-born.

Ligation of the Cord. As soon as respiration is established, the cord, in the absence of navel cord hernia, is firmly ligated at a distance of about one-half to one inch from the cutaneous line. The ligature should be aseptic, strong, and of sufficient size to prevent cutting into the walls of the vessels. The cord is then cut with clean scissors, about one-half inch from the ligature, on the placental side. It is unnecessary to apply two ligatures and cut the cord between them, as is sometimes recommended, except in case of twin births. By allowing the blood to escape from the placenta its volume is reduced and its delivery rendered easier. If, however, the bleeding from the cut end of the cord should be profuse, and continue for a considerable time, it is best to tie it. When the cord is unusually large, a part of the gelatinous portion may be stripped away, lest it retard desiccation, and by shrinkage loosen the ligature. If the first ligature does not entirely arrest the oozing of blood from the cut end of the cord, another should be applied nearer the body.

The Bath. The child is now wrapped in a previously warmed blanket or flannel. If much time has been consumed in establishing respiration, it may be well to place it in a basin of warm water for a few minutes, to warm its extremities and stimulate its circulation, before wrapping in the blanket. The water should not be warmer than 100° F. Care is necessary to avoid too much exposure of the new-born infant during the first few hours of its life. If its circulation is feeble, or if it seems weak or chilly, the first bath should be postponed, and its body heat be conserved by wrapping in cotton, with a shawl or blanket outside of this. Usually the cleansing may be proceeded with as quickly as possible. The bathing should be done in a warm room. During the process the infant should be protected from exposure. The sebum can easily be removed by covering the skin with a bland oil, such as sweet oil, lard, or vaseline, applied with the hand. Gentle friction may be necessary when the cheesy mass is tenacious. When the whole body has been freely and systematically anointed, the surface may be cleansed with soap and water; finally the infant is immersed in water at a temperature of about 95° F. It is then enveloped in a large towel and dried. Great care should be observed in thoroughly cleansing the eyes and mouth. For this purpose a saturated solution of boric acid or borax in water may be used. The eyes are to be thoroughly cleansed of all vaginal secretion by allowing the solution to drop from absorbent cotton that has been saturated with it. After this irrigation, small masses of matter still adhering may be removed by mopping the lids with the cotton. A careless and free use of soap is sometimes responsible for irritated or inflamed eyes. The mouth may next be gently washed out with a soft rag wet with a similar solution.

Care of the Cord. The stump of the cord, after being cleansed and dried, should have an extra ligature applied if required for safety, and then be wrapped in absorbent cotton or antiseptic gauze. Mummification of the stump is the chief object of the navel dressing. The application of oil or powder to the stump is to be omitted, since these agents tend to prevent a rapid desiccation. The time-honored dressing of linen rag with a hole in the centre, through which the stump protrudes, is permissible only when the linen cloth has been recently boiled. The stump when dressed is laid flat on the abdomen with the cut surface directed to the left, and kept in place by the ordinary belly-band. The cord usually separates in from four to seven days. When this occurs a small superficial ulcer is left that should soon heal. This also is to be kept dry, and may be dusted with boric acid.

Examination of Child. Before the bath, a careful inspection of all parts of the body should be made to detect possible malformations. This should include the head, mouth, neck, chest, abdomen, spine, anus, and genital organs. A rectal injection may be employed to make sure that the rectum is pervious.

The Clothing. After the bath the child is dressed. The belly-band may consist of light merino in summer and soft flannel in winter, reaching from the axillæ to the hips. It should not be applied too tightly for fear of embarrassing the movements of respiration. No general rule need be given in respect to the exact amount and character of the clothing. Two things, however, are essential: It should be sufficiently warm, as tested by feeling the child's hands and feet, and it must be loose enough to allow free play for movements of the hands and feet, and for respiration. During sleep the sides of the head and the neck and shoulders may be covered with a light shawl. It is, however, unnecessary, if not harmful, to cover the face so as to interfere with a proper supply of fresh air.

Maternal Nursing. After the mother has rested for six or seven hours, the infant may be applied to both breasts. This helps to establish the habit of suckling, and stimulates the mammary glands and the uterine contractions in the mother. *No other food should be permitted except by special direction of the medical attendant.* It should be remembered that the new-born infant is unprepared for digestion, and feeding is likely to do harm.

If there are reasons why the child should not be put to the breast at this early period, a teaspoonful of warm sterile water may be given at intervals of an hour or two if it is restless. The administration of water as a routine practice is useful for flushing the kidneys.

The mother, as a rule, should nurse her own infant. Natural nursing, for the first nine months, is so essential to the child's well being, especially in large cities, that nothing short of necessity should prevent it. Rarely, malformations of the nipples, depressed or retracted nipples, or extensive fissures may make nursing difficult or impossible.

To obtain the best results the greatest possible regularity in nursing must be observed. The child should not, as a rule, be allowed to nurse oftener than once in two hours during the day, and in four to six hours during the night. In its own interest and that of its mother, the child should not sleep in the bed with the mother, but in a crib. It is important for the mother's health, as well as for the quality of her milk, that she have six or seven consecutive hours of sleep at night.

One of the commonest causes of trouble comes from nursing the infant whenever it cries, for the purpose of quieting it. This is one of the most frequent sources of acute and of chronic infantile indigestion. Violent emotional paroxysms on the part of a nursing mother may so modify the milk as to produce acute indigestion or severe nervous disturbance in the infant. Convulsions, acute diarrhœa, collapse, and even death, have been known to result from this cause. Colic and indigestion in the infant are sometimes due to digestive derangements of the mother.

The infant should suckle the breast for about fifteen minutes at each nursing, and then fall asleep. If it is unsatisfied and fretful, after nursing for that length of time, there is probably insufficient milk in the breast or indigestion in the child. The breast milk may fail either in quantity or quality. If two little is secreted, stimulation of the gland and a generous diet are indicated. The most natural stimulation comes from the application of the infant at comparatively frequent intervals; a long interval is sometimes allowed with the mistaken idea that rest may enable the gland better to fulfil its functions.

A generous supply of nourishing and easily digested food is indicated. Oatmeal gruel, thin and well cooked, has a reputation for promoting the milk secretion, which seems to have some foundation in fact, although extended experiments seem to indicate that the chemical composition of the milk is but slightly affected by the character of the food provided a liberal supply is taken. A diet rich in preteid matters usually increases the per cent. of fat in the milk, but not the proteids. The liberal use of cows' milk has a like effect. Malt liquor, such as ale or porter, by stimulating the appetite, may indirectly aid the production of milk. The digestion and assimilation of the nursing mother often suffer for want of proper exercise, with the effect of impairing the quality and lessening the quantity of milk. Regular exercise in the open air must be advised as soon as circumstances permit.

It must not be forgotten that the mammary gland may act as an excretory as well as a secretory organ. This is especially true at the beginning of the lactation period, when great care must be exercised in giving drugs that may be excreted in the milk and affect the infant. Alcohol, opium, and belladonna are known to be thus eliminated in amounts sufficient to produce appreciable effects upon the infant.

Contraindications to Maternal Nursing. Most mothers prefer to nurse their offspring, and the physician should encourage adherence to the natural method of feeding in the absence of a definite contraindication. The following are the conditions which most frequently prevent or forbid nursing:

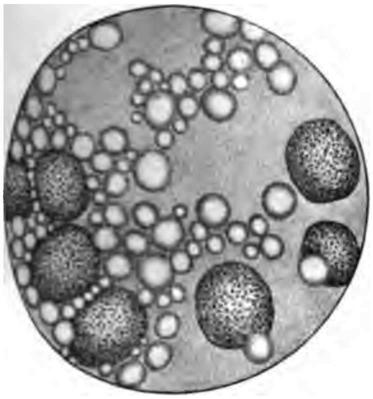
1. Depressed, or otherwise deformed nipples;
2. Diseases of the nervous system in general;
3. Epilepsy, when the seizures come oftener than twice a year;
4. Hysteria, especially after a pronounced hysterical disturbance;
5. Certain constitutional diseases, such as tuberculosis or syphilis;
6. Chronic diseases of the skin, such as eczema, prurigo, psoriasis, etc.;
7. Caries and chronic joint diseases;
8. Chronic rheumatism;
9. Advanced cardiac or renal disease;
10. Puerperal fever continuing more than two or three days;
11. Metrorrhagia when prolonged, since it has a very deleterious effect upon the composition of the milk. The appearance of the regular menstrual flow is not a contraindication to nursing unless the child shows signs of disturbance at the epochs;
12. Pronounced anæmia not easily corrected by treatment;
13. Abnormal milk, when it disturbs the digestion of the infant, and when it cannot be corrected by changes in the mother's diet or faulty habits.

Mother's Milk is a secretion of the mammary glands, consisting of an emulsion of fat suspended in a clear transparent liquid, in which sugar, caseinogen, lactalbumin, certain extractive matters and inorganic salts are dissolved. A good normal mother's milk has a bluish-white appearance, is more tranpsarent than cow's milk, and has a sweeter taste than the latter. It is neutral or slightly alkaline, frequently amphoteric in reaction, and has a specific gravity of 1026 to 1036. When examined under the microscope, the milk globules will be found to vary greatly in size; each is surrounded with a layer of more or less viscid material, which prevents them from running together. According to Woll, 1 c.c. contains 1.6 million globules, from 0.0024 to 0.0045 mm. in diameter.

Colostrum. The fluid secreted by the mammæ during the first three days after the birth of the child is called colostrum. It differs materially in composition from the true milk secreted later. It contains more proteid matters, less fat, and less sugar than milk. The amount of proteid varies greatly in different cases, from 2 to 8 or 9 per cent. We may take 2 to 3.5 per cent. as a fair average of the proteids during the first week of lactation. The proteids of colostrum are made up largely of albumin and globulin, instead of caseinogen. The fat of colostrum begins at about 2.5 per cent., and rises rapidly to 3.5 per cent. The sugar begins at about 5 per cent., and rises rapidly to 6.5 per cent. by the end of the second week.

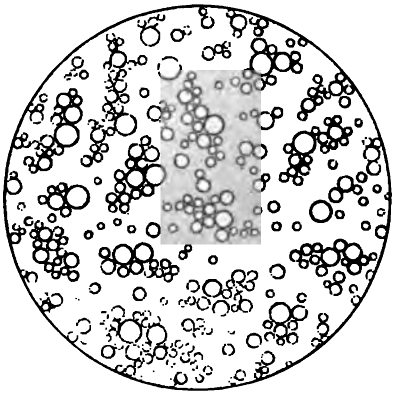
During the first eight or nine days after parturition, and sometimes later, the milk contains characteristic, larger bodies, known as colostrum corpuscles. These appear to be composed of masses of protoplasm containing fat. The colostrum corpuscles are four to five times as large as the fat globules. (Fig. 210.) They may occur in milk at any later time during the lactation period, and are then to be regarded as evidence of illness in the mother, or of pregnancy. Occasional colostrum corpuscles in the milk have little or no significance, but if present in considerable number they are liable to cause digestive derangement in the child.

FIG. 210.



Colostrum corpuscles

FIG. 211.



Normal human milk.

Normal Human Milk. Normal milk has the appearance seen in Fig. 211. In taking a sample of milk for microscopic examination, it should be drawn after the child has about half emptied the breast, and not at the beginning or end of the nursing. The microscope is often of value in showing the presence of blood, pus, or other foreign elements, but it is of little value as a guide to the richness of the milk, on account of the difficulty in securing a sample that represents the average secretion of the breast. The centrifuge should be used to separate the cellular elements in the microscopical examination of the milk. The length of time the milk has remained in the breasts exerts an important influence upon the number of globules it contains. The longer the period of retention the more watery it becomes, probably from absorption of the solid parts. On the other hand, milk that is frequently taken from the breast is thicker from being richer in fat.

Abnormal Mother's Milk. It occasionally happens that an apparently healthy mother secretes an abnormal milk that disagrees with the infant. The constituents most subject to variation are the fat and the proteids. Our knowledge of the causes of these variations is, unfortunately, imperfect. Rotch and Adriance find that a diet rich in nitrogenous matter tends to increase the fat in the milk, while an abundance of fat in the food tends to diminish it. Excess of proteids is usually more troublesome than any other abnormality. Rotch also pointed out that an over-liberal diet, with little exercise, may increase the proteids in the milk; a less generous diet, with abundant out-door exercise, may correct this abnormality. Marked emotional disturbance frequently increases the proteids temporarily and causes colic in the nursling.

The following table of variations in human milk, from Rotch, is of interest in this connection :

	Normal. Normal exercise and food.	Poor. Starvation.	Very rich, Generous diet. Little exercise.	Bad Milk. Pregnancy. disease, etc.
Fat	4.0	1.50	5.10	0.80
Proteids	1.2	2.40	3.50	4.50
Sugar	7.0	4.00	7.50	5.00
Ash	0.2	0.09	0.25	0.09
Total solids	12.13	7.99	16.35	10.39
Water	87.87	92.01	83.65	89.61
	100	100	100	100

When there is reason to believe that the mother's milk is not agreeing with her infant, an excess of casein should be suspected, and an analysis by a chemist may reveal the fault if it lies in the milk, and point out the way to its correction. It is advisable in all such cases to examine carefully into the mental and physical habits and characteristics of the mother.

Daily Quantity of Milk Secreted. The daily amount of milk secreted by the average mother, and the weight of each feeding and of each constituent at different periods of lactation, are given in Table I. (page 277), from Pfeiffer. The results were obtained by weighing a series of infants before and after each nursing, and adding the weights of all the feedings for the twenty-four hours. The weights of each constituent were obtained by calculation from the known composition of the milk as determined by chemical analysis.

Variations in Quantity and Composition of Human Milk. It will be noted that the quantity of milk secreted increases gradually from the beginning of lactation until about the tenth week, then remains practically stationary until the sixth month, when it increases somewhat, and finally decreases. Human milk varies considerably, both in quality and quantity, in different individuals, and even in the same individual,

TABLE I.

Age of infant.	Total amount in grammes.	Number and weight of each meal.	Proteids in grammes.	Fat in grammes.	Sugar in grammes.
1 month.					
½ week	104	8 × 13	4.40	2.81	4.69
1 "	254	7 × 36	8.74	6.86	11.44
2 weeks	334	7 × 48	7.64	12.13	15.05
3 "	449	7 × 68	10.27	12.13	20.23
4 "	550	7 × 71	12.58	17.86	24.78
2 months.					
5-6 weeks	749	7 × 107	13.82	22.52	41.47
7-8 "	864	7 × 123	15.83	26.40	45.08
3 months.					
9-10 weeks.	926	7 × 132	17.68	20.43	55.28
11-12 "	896	7 × 128	17.10	20.25	53.50
4 months.					
13-14 weeks	966	7 × 138	19.53	39.02	59.12
15-16 "	974	7 × 139	19.62	39.23	59.39
5 months.					
17-18 weeks	996	7 × 142	17.38	52.86	
19-20 weeks	996	7 × 142	17.42	52.28	
6 months.					
21-22 weeks	1023	6 × 167	15.82	26.88	60.00
7 months.					
25-28 weeks	1051	6 × 174	15.99	31.77	60.40
8 months.					
29-32 weeks	741	6 × 124	12.15	28.69	42.80
9 months.					
33-36 weeks	482	6 × 88	7.26	11.62	28.94

because of varying physiological and pathological conditions relating to food, nutrition, duration of lactation, length of time the milk remains in the breast, exercise, menstrual function, emotions, and nervous affections.

It is, therefore, very difficult to arrive at the normal composition of human milk, since these disturbing elements have not been taken into account in most of the published analyses. *Analyses of human milk by different chemists differ so widely that it is difficult as yet to determine the typical normal standard.* In general, it may be stated that during the first week of lactation colostrum is secreted, containing less fat and sugar than normal milk, more proteids (the greater part of which is lactoglobulin and lactalbumin), and more salts.

The fat and sugar rapidly increase after the third day till the end of the first month; from that time the proportions of these ingredients remain constant until about the eleventh month, when they fall off. The proteids and salts exist in much larger percentages in colostrum than in normal milk, the former containing on an average 2.5 to 3.5 per cent. of proteids and 0.4 to 0.5 per cent. of salts. Both these constituents gradually diminish until the eleventh month, when they again slightly increase. During the first month of lactation, human milk contains between 1.5 and 2.5 per cent. of total proteids; during the second about 2, and in the third about 1.5 per cent.

The percentage of iron falls off as lactation proceeds, and after the eighth or ninth month it becomes decidedly less than normal. The milk of the early months of lactation, then, is characterized by a large percentage of proteids and salts, and a small percentage of sugar. That of the later months is characterized by a smaller percentage of proteids and salts, and a higher percentage of sugar. The smaller proportion of proteids and of iron in the later months contraindicates prolonged nursing. When children are nursed too long (beyond the eleventh month) they frequently show symptoms of malnutrition, and often become anæmic or rachitic.

It is of interest to note that the composition of the milk varies greatly, according to the time it has remained in the breast. Forster gives the following analyses of the first, the middle, and the last portions taken from the breast during an ordinary nursing :

	First portion.	Second portion.	Last portion.
Amount taken	33.1 c c.	33.1 c c.	37.3 c.c.
Water	90.24 per cent.	89.68 per cent.	87.50 per cent.
Proteids	1.13 "	0.94 "	0.71 "
Fat	1.70 "	2.77 "	4.51 "
Sugar	5.56 "	5.70 "	5.10 "
Ash	0.40 "	0.32 "	0.28 "

It is evident from the foregoing figures that care must be observed in obtaining a sample of milk for analysis, if we wish to secure results that are comparable or that will represent the real composition of the secretion. The middle portion only should be taken, after the child has nursed one-third of its usual time. These analyses also show that in too frequent nursing the child gets only "strippings," or over-rich milk, likely to disturb digestion.

Substitute Feeding.

Wet-nursing. When, after proper effort, the mother is unable to nurse her infant, wet-nursing may be considered. So difficult is it to secure a good wet-nurse that the uncertainties of this method are often scarcely less than those attending artificial feeding. The expense, too, of substitute nursing places it beyond the reach of the masses.

The moral character and social standing of most women who are willing to wet-nurse are such that many families shrink from taking them into their homes. While the danger of the transmission of syphilis or tuberculosis by an apparently healthy nurse has been overestimated, it is, nevertheless, a real one, and no woman the subject of either of these diseases should be allowed to nurse an infant. There are many instances on record in which syphilis has been communicated in this way.

While healthy breast milk is undoubtedly the best food for an infant, it is equally true that with a proper knowledge of the best modern methods of substitute feeding there is now little need of resorting to wet-nursing.

Mixed Feeding. It frequently occurs that the mother is able only to partially nurse her baby. In such cases mixed feeding should be resorted to—*i. e.*, the mother should nurse the infant at regular intervals, and the nursing should be supplemented by two or more artificial feedings in the twenty-four hours. The practice of nursing only at night, which is sometimes advised, is objectionable. Regularity of nursing is essential to the continuance of the secretion. Mixed feeding may sometimes be rendered necessary by the transient illness of the mother, or by a temporary deficiency occasionally resulting from unassignable causes or from nervous or emotional influences. In some instances the secretion may be restored by faradization of the breasts or by change of surroundings.

Artificial or Bottle Feeding. When good breast milk is not available, artificial food must be provided, and its preparation must be managed with scrupulous care. When it becomes necessary to practise artificial feeding from birth, we may, with advantage, use whey made from cows' milk for the first few days. For this purpose the whey should be made by warming a pint of best rich whole milk to about 37° C. (98.6° F.), adding a teaspoonful of liquid rennet, essence of pepsin, or a junket tablet. When curdling has taken place the mixture is vigorously stirred until the curd collects into a lump. The whey is strained through sterilized cheesecloth, and put on ice until needed. Whey made as above, from good, rich milk, will have approximately the following percentage composition (Monti):

Casein.	Soluble Proteids.	Fat.	Sugar.	Salts.	Water.
0.03	0.8	1.0	4.5	0.70	93.0

About two ounces of this whey warmed to blood-heat may be given during the first twenty-four hours to an infant of average size. Four ounces may be given the second day, and from eight to ten the third. The fourth or fifth day a little cream may be added to the whey, and a little sugar if desired.

A substitute food for continued use should fulfil the following requirements: (1) It should correspond in composition, digestibility, temperature, reaction, and quantity as nearly as possible, to normal human milk. (2) Its preparation should be as simple and uncomplicated as possible. (3) It should not be expensive, and should be easily obtainable. The basis of an infant food must be milk, and in this country the only easily obtainable animal milk is that of the cow. Great care is necessary in selecting the milk. It should be the mixed milk of a herd, and not that from a single cow, since the former is more nearly of constant quality. It should be as fresh as possible, and clean. Milk from grass-fed cows is to be preferred. For use in large cities milk that has been bottled at the dairy, and subjected to the least possible amount of handling in shipping, is best.

Difference between Human and Cow's Milk. To understand properly the modification of cow's milk for infant feeding it is obviously necessary to know the differences in composition and properties between it and human milk. Some of the more important differences are shown in the following table:

	Human milk.		Cow's milk.	
	Percentage.	Average.	Percentage.	Average.
Water	83.69 to 90.00	87.09	80.32 to 91.50	87.41
Solids	9.10 " 16.11	12.46	8.50 " 19.68	12.50
Fat	1.71 " 7.60	3.90	1.15 " 7.09	3.66
Sugar	4.11 " 7.80	6.36	3.20 " 5.67	4.50
Casein	0.18 " 1.98	1.03	1.17 " 7.40	3.01
Albumin	0.39 " 1.35	1.00	0.21 " 1.50	0.53
Citric acid	0.01 " 0.10	0.05		
Unknown extractives	0.29 " 0.97	0.69		
Ash	0.11 " 0.40	0.27	0.50 " 0.78	0.70
Calories furnished by 100 c.c. (3.5 ounces)		69.00		67.00

It will be seen that the range of variation in composition of both milks is very considerable. These variations include abnormal or pathological conditions, and will largely disappear when the mixed milk of several individuals is considered. Mixed cow's milk of good quality will not vary much in composition from that given in the column marked "average." When the averages of the two milks are compared, we observe that human milk is slightly richer in fat, one-third richer in sugar, twice richer in albumin, and contains one-third as much casein (precipitable by rennet), and a little more than one-half as much ash as cow's milk. The most marked quantitative differences are in the sugar and the proteids. The proteids are chiefly casein and albumin, although a small quantity of a peculiar globulin is also present. The casein, or that part of the proteids which is precipitated in the human stomach by rennin or by the gastric acid, is three or more times as great in cow's as in human milk. By reason of this, as well as differences in composition of the two kinds of casein, the curd of cow's milk is larger in amount, tougher in consistence, and less easily digested than that of human milk. Indeed, the casein of human milk is only partially precipitable by acids, and in some cases imperfectly by rennin. The soluble albumin in human milk is twice that of cow's milk. About half the proteids of human milk remain in solution until they leave the stomach, while four-fifths of the proteids of cow's milk are precipitated in a solid curd soon after it enters the stomach. The relation between the quantity of lactalbumin and casein is a matter of great importance in determining the behavior of the milk when coagulated. In the presence of a considerable amount of soluble albumin the casein coagulates in fine flocculi, while without it these are much larger and show a tendency to collect in masses. The normal ratio between albumin and casein in human milk during the first month of lactation is nearly 1 to 0.8 while in cow's milk it is nearly 1 to 7. Camerer gives the ratio in human milk as 1 to 0.6 during the first month. Monti has called attention to the fact that when the proportion of albumin to casein is diminished the infant generally suffers with digestive disturbance. The proportion of total proteids in human milk is greater during the first weeks of lactation than afterward, and the ratio of albumin to casein is greater. During the later months of lactation the amount of albumin falls below that of the casein. These differences in the composition of the proteids of human and cow's milk are too often lost sight of in attempts to adjust the latter to suit the digestion of the infant. These differences in composition and behavior of the proteids of the two milks explain why the the infant experiences so much difficulty in digesting cow's milk. But these are not the only differences in the proteids. Human milk contains, according to Siegfried[1] and Stoklassa,[2] about 0.12 per cent. of nuclein, and about the same percentage of lecithin, including nearly all the phosphorus of the milk in this organic combination. Cow's milk contains less than half as much nuclein and lecithin. But one-half of the phosphorus of cow's milk is organic or tissue-building phosphorus. From what we know of the nutritive value of nuclein and lecithin, it would seem that cow's milk, even when fed in the undiluted state, cannot nourish an infant as well as human milk. Boiling or sterilizing destroys much of both the nuclein and lecithin of cow's milk, and greatly reduces the nutritive value of the milk. This will be referred to later in considering sterilized milk.

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[1] Zeitschr. f. phys. Chem., 1896, p. 576.

[2] Ibid., 1897, p. 343.

TABLE II.—HUMAN AND COW'S MILK COMPARED.

	Human Milk.	Cow's Milk.
Appearance	Bluish, translucent, odorless, sweetish.	White, opaque, odor, and slightly sweet taste.
Specific gravity	1026 to 1036.	1030 to 1036.
Reaction	Amphoteric or alkaline. Remains alkaline a long time.	Amphoteric or acid. Rapidly becomes acid in the air.
Behavior on boiling	Does not coagulate, but forms a very slight film of albuminoid matter.	Does not coagulate, but forms a thicker film consisting of casein and lime salts, which, when removed, is rapidly renewed.
Coagulation	Coagulates at ordinary temperature after many hours.	Coagulates much earlier than human milk.
Coagulation with rennet	Coagulates incompletely in fine flocculi, which never precipitate in distinctly visible masses.	Coagulates at body temperature, and separates into distinct masses, leaving a supernatant yellowish liquid.
Fat	Yellowish-white, similar to cow's butter; specific gravity at 15° C. = 0.966; melts at 34° C. Composition: butyrin, caproin, caprin, myristin, palmitin, stearin, and olein.	Yellowish-white mass, specific gravity at 15° C. = 0.996; melts at 35.8° C. Composition: butyrin, caproin, caprin, palmitin, stearin, olein, myristin, caprilin, laurin, arachin, leucitin, cholesterin, and yellow coloring matter.
Relation of fatty acids	Relatively poor in volatile acids; of the non-volatile acid sone-half is oleic; of the remainder, myristic and palmitic predominate.	The volatile acids relatively large. Of the non-volatile acids, 3 to 4 per cent. is oleic; the remainder is a mixture of principally palmitic and stearic.
Casein . . .	Precipitated with difficulty by acids and salts; the precipitate dissolves easily in excess of acids. In peptic digestion it leaves little residue. Contains little $Ca_3(PO_4)_2$.	Easily precipitated by acids and salts; precipitate not easily dissolved by excess of acids. In pepsin digestion it leaves considerable residue. Contains more $Ca_3(PO_4)_2$ than human milk.
Composition of proteids	Albumin 1.1 per cent., casein 1 per cent., globulin 0.1 per cent., albumin to casein, 1 to 0.8 to 1 to 2. 100 c.c. contain 0.175 gramme lecithin and 0.120 gramme nuclein. Nearly all the phosphorus is in organic combination.	Albumin 0.53 per cent., casein 3 per cent., globulin trace, albumin to casein 1 to 6 to 1 to 10. 100 c.c. contain 0.110 gramme lecithin and 0.055 gramme nuclein. Less than half the phosphorus in organic combination.
Extractives	More than in cow's milk.	Less than in human milk.
Mineral matters in ash	K_2O Na_2O CaO MgO Fe_2O_3 P_2O_5 Cl 0.780 0.232 0.328 0.064 0.004 0.473 0.438 Contains less ash than cow's milk.	K_2O Na_2O CaO MgO Fe_2O_3 P_2O_5 Cl 1.72 0.510 1.98 0.200 0.003 0.820 0.980 Contains more ash, especially CaO and PO Contains 6 times as much Ca_2O_5 as human milk.
Bacteria . .	Generally sterile. Exceptionally a few staphylococci albi and s. aurei.	Contains all milk bacteria, and occasionally typhoid, diphtheria, tubercular, and other bacteria.

Modified Cow's Milk. The above-described differences between human and cow's milk make it necessary to modify the composition of the latter to render it available for infant feeding. No modification yet known, however, will bring cow's milk to agree in composition with human milk or make it a perfect substitute for the natural food. The modifications of cow's milk that are most frequently practised are the following:

1. Simple dilution with water;
2. Dilution with cereal gruels, such as barley, oatmeal, corn-starch, wheat-flour; or with gelatin, gum arabic, egg albumin, or sugar-water;
3. Dilution with water, or sugar-water, and the addition of cream;
4. Partial creaming, using the upper half, including the cream, and adding sugar-water and lime-water;

5. Removing a part of the casein by means of rennin or by the centrifugal machine;

6. Partial peptonizing of the proteids, and dilution with water;

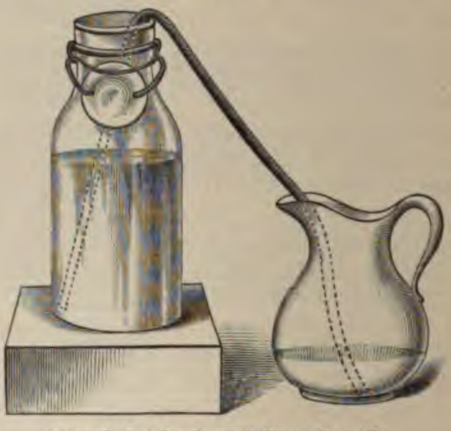
7. Mixtures of milk, cream, sugar, and water, made according to chemical analysis, to contain a known percentage of each constituent.

Dilution with water, to the extent required by the excess of proteids in cow's milk, reduces the fat and sugar below the proportion necessary for the nutrition of the infant, and such modification alone is seldom successful.

The Author's Methods of Modifying Cow's Milk. The only rational and practical household method of modifying cow's milk for infant feeding is to dilute the milk so as to reduce the casein to 1 per cent. or less, then to add cream to bring the fat up to 3 or 3.5 per cent., and milk sugar to bring this constituent to 6 per cent. The simplest and most practicable method of doing this is as follows:

When the milk is received it is allowed to stand in a cool place for three hours. When the milk is received in bottles, as is now the custom, it is better to remove the bottom milk by means of a siphon, consisting of a piece of small rubber tubing about eighteen inches long, leaving the cream layer and top milk undisturbed in the bottle (Fig. 212).

FIG. 212.



Method of siphoning off the under milk.

When two-thirds of the contents of the bottle are thus drawn off, the remaining portion will have approximately 7.5 to 8 per cent. of fat, 4 per cent. of proteids, and 4.5 per cent. of sugar.

When one-half of the milk is thus drawn off, the remainder will have, when shaken up, about the following composition: Fat, 5 to 6.5 per cent.; proteids, about 4 per cent.; sugar, 4.5 per cent.

Directions for Preparing a Near Imitation of Human Milk from Cow's Milk. "Siphon off from the bottom of a bottle of fresh milk of good quality *three-fourths* of its contents, leaving the cream and upper part of the milk undisturbed in the bottle. This may easily be done with a small glass siphon or rubber tubing, previously filled with water, to start the siphonage. Pinch one end of the rubber tube and hold it firmly, while the other is thrust through the cream and to the bottom of the bottle. Lower the outer end into a suitable vessel, or, better, into the inner vessel of an ordinary *double boiler*, and release it, when the skim-milk will run out, provided the latter vessel is kept lower than the milk in the bottle. To the milk thus drawn off add a teaspoonful and a half of good essence of pepsin, or one or two junket tablets, and warm slowly in the double boiler to blood-heat, and keep at that temperature until thoroughly curdled. Now heat, with constant stirring, until a thermometer dipped into the milk shows a temperature of 155° F., and remove from the fire. Strain, while hot, through clean wire strainer and dissolve in the whey a heaping tablespoonful of sugar of milk. When cold, pour the sweetened whey back into the milk bottle and mix thoroughly with the cream and top milk. Pasteurize the mixture in a Freeman's pasteurizer. The composition of this food will be about as follows: Fat, 3 to 3.5 per cent.; caseinogen, 0.9 per cent.; albumin, 0.75 per cent.; sugar, 6 per cent.; extractives, 0.26 per cent.; ash, 0.7 per cent.; total solids, 11.66 per cent.; water, 88.34 per cent. On comparing this with the analysis of human milk in the above table of composition, it will be seen to correspond very nearly with it.

"The close resemblance of this mixture to human milk is seen by comparison. This mixture will, if properly made, correspond more nearly in composition to human milk than any other known to the author. One very important consideration in regard to this food is the relation between the casein and the lactalbumin, which, while it is not exactly that of human milk, corresponds more nearly to it than can be attained by any other method of dilution. This is very important in its effect on the consistence of the curd. This mixture, when coagulated with acid, behaves very strikingly like human milk. The fat has not been removed from the milk, and, therefore, the emulsion has not been destroyed, as is the case in all mixtures made with centrifugal cream.

"An extensive experience with this food has shown it to give good clinical results. It is palatable, agrees with most infants, and promotes growth and development quite satisfactorily.

"*Note.*—Should this food prove too laxative, reduce the quantity of milk-sugar. It is well to add, at the time of feeding, from one to two teaspoonfuls of lime-water to each meal. As the child increases in age and strength the amount of bottom milk siphoned off may be diminished."

I have, at times, found it necessary to show the mother how to conduct the process, but only mothers below the average intelligence.

One great benefit of this process is its pliability, or the ease with which the constituents may be varied. If we wish to reduce caseinogen, we draw off more of the bottom milk. To increase it, draw off less. To decrease the fat, dip off a part of the cream, remembering that the whole amount of cream measures from ten to twelve tablespoonfuls; to increase the fat, add a little less than the full amount of whey, after removing the curd. To increase the soluble albumin, add white of egg. The sugar may be varied at will, by adding more or less, as desired.

It will occasionally be found, even with a food in which the casein has been reduced, by one of the above methods, to one-third or one-fourth that found in cow's milk, that curds will appear in the stools of the infant. In such cases a little white-of-egg water or barley gruel added to the food may promote the disintegration and digestion of the curds.

When egg-albumin is added to the food, the egg must be as fresh as possible, and it may be added in the proportion of the white of one egg to a quart of food. This will add about 3 grams of albumin to the quart, or approximately 0.3 per cent. of soluble albumin, increasing that constituent in this food to about 1 per cent., or to that found in human milk. Unless the egg used is fresh, this addition may at times, especially in hot weather, tend to produce putridity of the infant's stools.

Peptonized Milk. In some cases *partial peptonization* may be necessary. This is accomplished by the following process: To a pint of the milk add 5 grains of extractum pancreatitis and 15 grains of sodium bicarbonate. Warm the milk slowly to 104° F., and keep it at that temperature for ten minutes, then bring it nearly to the boiling-point, to destroy the ferment. Instead of heating the milk to the higher temperature, it may be placed at once on ice. Peptonization may do good for a short time, but experience has shown that it is rarely well borne when long continued. It seems better to allow the digestive juices of the infant to accomplish the necessary changes in the food than to induce them outside of the body. If predigestion is practised at all, the process should not be carried beyond a partial digestion. This principle applies with equal force to all the predigested or partially digested foods of the markets. Experience has shown that none of them is successful except for a time.

Cream Mixtures. The results obtainable with the mixtures above described will be better, as a rule, than with home-made mixtures of milk, cream, and water, because the best obtainable cream, in large cities, is usually decidedly acid and teeming with milk bacteria. This is especially true of gravity cream. Preparations made with such cream are very liable to produce acid fermentation in the infant's stomach, with vomiting. Centrifugal cream, when fresh, has the advantage that it is usually fairly uniform in composition, and may be obtained of known fat content. It has the disadvantage that the natural emulsion is broken up by the process of separation, the fat globules being collected in small lumps. The fat is, consequently, less easily digested by the infant. This objection is a serious one when the cream is kept some time after the separation, before using.

Mixtures of milk, cream, water, sugar, and lime-water have been recommended by Biedert, Meigs, Rotch, and others for many years. Rotch's mixture differs from that of Meigs principally in containing less lime-water. It is made as follows:

Cream (20 per cent. of fat)	1½ ounces.
Milk	1 ounce.
Milk-sugar	3⅜ drachms.
Water	5 ounces.
Lime-water	½ ounce.

Vigier's Method. A method of preparing a close imitation of human milk, suggested by Vigier in 1893, is as follows: Divide a quart of milk into two equal portions. Let both stand three or four hours in a cool place, skim the cream from one portion and add this to the other. To the skimmed portion add a teaspoonful of *liquid rennet;* warm to 35° to 40° C. (95° to 104° F.) for fifteen to twenty minutes, with frequent stirring, or until it forms a tough curd. Then heat to 68° C. (155° F.) and strain through muslin and cool. The whey so prepared from good milk will contain, of casein, 0.03 per cent.; albumin, 0.80 per cent.; fat, 1 per cent.; sugar, 4.5 per cent., and salts, 0.70 per cent. It contains a little more soluble proteid than the milk from which it is prepared. For infants under five months of age, mix equal volumes of this whey and the enriched milk; for infants over five months, mix two parts of milk with one of whey. The composition of this food will be nearly as follows, expressed in percentages:

	Casein.	*Albumin.*	*Fat.*	*Sugar.*	*Salts.*
Equal volumes of whey and milk .	1.22	0.66	2.33	4.5	0.7
Two parts milk and one part whey .	1.61	0.61	3.11	4.5	0.7
Average human milk . . .	1.03	1.20	3.90	6 04	0.4

Monti uses a mixture of whey and milk, in the proportion of equal volumes for the first three months; after that time he uses a mixture of two parts of milk and one of whey.

Chapin, of New York, prepares an infant food by home modification of cows' milk by dipping the cream from a bottle of market milk with a special dipper holding one ounce. By removing in this way nine dipperfuls from the top of a quart bottle there are obtained nine ounces of a rich milk, containing approximately 12 per cent. of fat and 4 per cent. of total proteids. This is then diluted with dextrinized cereal gruel sufficient to make thirty-six ounces. The composition of this food will be approximately: Fat, 3 per cent.; milk-proteids, 1 per cent.; sugar, 1.1 per cent.; of dextrin, cellulose, cereal-proteids, and salts, an unknown amount. Milk-sugar is added to increase this constituent to about 6 per cent. To increase the amount of milk-proteids in the finished product, it is only necessary to dip off nrore dipperfuls of the top milk, and add less than three times as much gruel. To increase the fat without increasing the proteids, a less amount of cream is dipped out, say six ounces. He shows that this cream, if carefully dipped from the cream layer of an ordinary quart bottle of well-creamed milk, will contain about 20 per cent. of cream and about 4 per cent. of proteids. If to this cream four volumes of diluent are added, the mixture will contain about 0.8 per cent. of proteids and 5 per cent. of fat. The sugar will be reduced to about 0.9 per cent., and 5 per cent. of sugar must be added, or a little over 1.5 ounces.

In this method of modifying cows' milk the author believes that the casein is not only reduced to such a quantity that the infant can digest it, but that it is rendered more digestible by the fact that the coagula are rendered flocculent and easily disintegrated by the presence of dextrin and the presence of the soluble proteids of the cereal. The soluble proteid is increased by the gruel, especially when oatmeal or barley is used, and thus the ratio between this and the casein is made more nearly like that of human milk, although the amount added is necessarily an unknown quantity. The carbohydrate content of this food is increased by the addition of dextrin and maltose, so that this constituent is out of the natural proportion as found in human milk. When prepared by unskilled hands the quantity of maltose formed must vary somewhat; but its presence ought to make the addition of sugar unnecessary, could we know how much sugar is thus added.

Gärtner's Milk. Gärtner, of Vienna, has recently placed upon the market a milk containing one-half the normal proportion of casein in cow's milk while retaining nearly the full percentage of fat.

The relation of albumin to casein in this milk is as 1 to 7, or the same as that obtained by diluting milk with an equal volume of water. The milk, then, has nearly the following composition, expressed in percentages: Casein, 1.75; albumin, 0.27; fat, 3; sugar, 2.25, and salts, 0.35. Its reaction is faintly acid; its specific gravity is 1020 to 1025, and it has a pleasant, though feebly sweet taste. The latter defect is met by the addition of milk-sugar. It coagulates with acid in finer flocculi than cow's milk, and has been used with some success in infant feeding. It has the disadvantage that the relation of soluble albumin to the casein is that of cow's milk, and not that of human milk. In this respect it is inferior to the mixture of whey and milk above described. It has the further disadvantage that the fat globules conglomerate into masses, which cannot afterward be emulsified again, rendering the fat difficult of digestion. It is supplied in the markets in tin cans, like condensed milk, and is previously sterilized by heat. It, therefore, has all the disadvantages of sterilized milk, mentioned under that heading.

The Mechanical Method of modifying milk consists in adding thin gruels, made with the cereal grains or dextrin, to cow's milk. They attenuate the clot of casein, so that it becomes more flocculent, like that of woman's milk. Barley-water is most commonly used for this purpose. The only disadvantage in giving it to very young infants is due to the starch it contains. Before the third month, owing to the fact that the salivary and pancreatic glands are slightly developed, very little starch can be digested. Most of the prepared infant foods contain too much unchanged starch for a young infant's digestion. What is desired is a flour containing the albuminoid constituents of the grain, carbohydrates, in soluble form, and but little of the insoluble starch.

Sterilized Milk. In all large cities, and whenever cow's milk cannot be obtained "fresh from the cow" twice a day, it is necessary to adopt some means of checking the fermentative changes in it. Experiments show that cow's milk when first drawn from the udder, under the usual conditions, contains from forty to several hundred bacteria in each cubic centimetre. After six hours it contains from 5000 to 10,000 in each cubic centimetre. These bacteria multiply very rapidly, producing detrimental changes in the milk, unless their growth is checked by a very low temperature, by the use of antiseptics, or by the application of heat. The well-known process of sterilization consists in heating the milk to 100° C., 212° F., for a sufficient time to destroy the bacteria, and most of the spores of bacteria, without producing too great changes in the taste of the milk. In practice, the time of heating varies from fifteen to forty-five minutes. Complete sterilization can be accomplished only by heating the milk to 110° C. for fifteen minutes.

Sterilization at 100° C. produces the following changes in the milk, which are undesirable:

1. A part of the sugar is decomposed or caramelized, giving the milk a disagreeable taste;

2. The fat is melted, the emulsion largely destroyed and rendered less digestible;

3. The casein is changed, so as to be less easily affected by rennet, and when coagulated it forms tough indigestible curds, which may be found in the stools;

4. The albumin and globulin are coagulated, and made capable of precipitation with the acids of the gastric juice, thus increasing the size and toughness of the curd formed in the stomach, and making it less easily digestible;

5. The nuclein and lecithin of the milk are largely destroyed, and the peculiar nutritive function of these bodies is lost. It is probable that this is the cause of the loss of antiscorbutic properties in sterilized and in condensed milks;

6. The salts are rendered more insoluble; especially is this true of the phosphates.

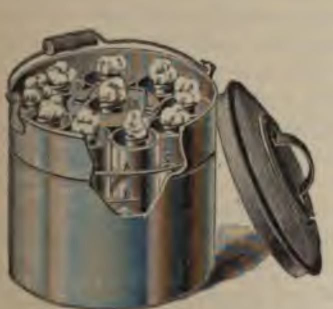
Children fed exclusively upon sterilized milk fail to thrive as well as when fed upon unsterilized milk, and show a tendency to develop rachitis.

The advantages of sterilized milk are:

1. The destruction of disease germs;
2. The prevention, to a great extent, of the accidents due to sour milk;
3. The increased keeping quality of the milk, without ice, and on long journeys.

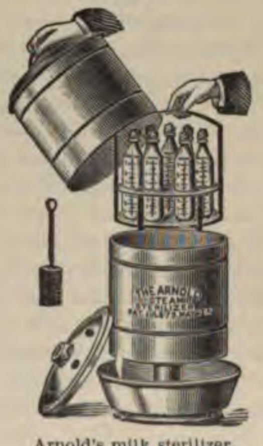
Pasteurization or Partial Sterilization at a temperature not exceeding 70° C., 158° F., has now practically superseded complete sterilization.

FIG. 213.



Freeman's Pasteurizer.

FIG. 214.



Arnold's milk sterilizer.

st proteids coagulate at 73° C. to 75° C. (163.4° F. to 167° F.), ile lactalbumin coagulates at 77° C. (170.6° F.). The temperature ould not, therefore, be allowed to reach 77° C. (170.6° F.). This perature is above the thermal death-point of the lactic-acid ferment nd of most pathogenic organisms. The bacillus tuberculosis, the bacillus typhosis, bacillus diphtheriæ, and bacterium lactis are all killed by fifteen minutes' exposure to a temperature of 65° C. (149° F.).

The simplest and most practical Pasteurizer in the market is that devised by Dr. Freeman, of New York, Fig. 213. It consists of a tin pail provided with a groove to indicate the amount of water to be added. The water is heated to boiling on an ordinary cooking-stove. The milk, contained in bottles plugged with cotton, is placed in the zinc cylinders of the rack, the space about them filled with water, and lowered into the boiling water, the cover put on, and the pail removed from the stove. The latent heat of the water is just sufficient to heat the milk to about 68° C. (154.4° F.), when all the bottles are filled. After half an hour the cover is removed, the rack containing the bottles is raised partly out of the water, and cold water run into the pail until the milk is cold. This process will greatly increase the keeping quality of the milk without perceptibly changing its chemical properties or taste. Arnold's milk sterilizer, too, may be used for pasteurizing, but it is not so easy to secure a fixed and certain regulation of the temperature. The temperature varies with the rapidity of the boiling of the water (Fig. 214).

Condensed Milk. Condensed milk has been a popular food for infants ever since its introduction. The canned milk which contains cane-sugar added as a preservative is most commonly used. The makers claim that such milk is condensed to one-fourth the original volume, but analysis shows that it is usually condensed to one-third—*i. e.*, when diluted with two volumes of water it will give a liquid containing the same percentages of milk-solids as the original milk, together with about 12 to 13 per cent. of cane-sugar. Meigs has shown that when one part of the best commercial sweetened condensed milk is diluted with nine parts of water, the mixture somewhat closely corresponds in composition with human milk, with the exception that it is deficient in fat and contains cane-sugar for a part of the lactose. A mixture of one part of condensed milk, one part of Pasteurized cream (containing 12 per cent. of fat), and eight of water, more closely resembles human milk in composition. While many infants will apparently thrive on this mixture, it has all the disadvantages of sterilized milk, and infants fed upon it almost invariably sooner or later show signs of rachitis.

It should be remembered that sterilization and pasteurization are sanitary measures used to protect infants from dirty or contaminated milk. When a clean, pure fresh milk is to be had they should not be employed, as the infant will thrive better on the raw milk.

Milk Laboratories. During the past few years milk laboratories have been established in some of the large cities, with the object of securing greater accuracy in the artificial feeding of young infants. The Walker-Gorden Company were the pioneers in this field, and are now operating laboratories in New York, Philadelphia, Boston, Chicago, Baltimore, and Montreal. The physician writes directions for an infant's food, and sends them to these laboratories, just as he orders drugs by prescription.

It is found that slight changes in the percentages of fat, sugar, and proteids may be of great value in managing cases of indigestion and malnutrition in the infant. The following is Dr. Rotch's working basis, deduced from the study of normal average breast milks for the first three months of life. It must be understood, however, that these figures may require modification to suit individual cases.

	I.	II.	III.	IV.	V.
Fat	2.00	2.50	3.00	3.50	4.00
Milk-sugar	5.00	6.00	6.00	6.50	7.00
Albuminoids	0.75	1.00	1.00	1.50	1.50
Mineral matter	0.11	0.17	0.17	0.25	0.25
Total solids	7.86	9.67	10.17	11.75	12.65
Water	93.14	90.33	89.83	88.25	87.25

The following may be given as a sample prescription to be tried for a new-born infant after the second day:

Fat	2 per cent.
Sugar	5 "
Proteids	0.75 "
Lime-water	5 "
Number of feedings	10

Put up in ten bottles, each containing one and a half ounce. Pasteurize at 167° F. for fifteen minutes.

Should this mixture agree the sugar and fat should be increased at the end of the first week by one-half per cent. The sugar may be increased to 6 per cent. at the end of the second week, unless the child has colic. It is not always easy to determine the cause of the disagreement, but a few trials with varying percentages of fat, proteids, and sugar will enable the practitioner to adapt the food to the needs of the individual case.

It will seldom be necessary to depart from the known variations in human milk, as given in the table on page 274.

Too large a percentage of sugar may cause greenish, acid stools and colic, and too low a percentage will usually lead to dry stools and failure of the proper increase in weight.

Too large a percentage of fat may give rise to vomiting, diarrhœa, and fatty masses in the stools. In some cases an excess of fat may cause colic. A deficiency of fat frequently occasions constipation, with dry, hard stools. The fat should rarely be increased above 4 per cent., and it is seldom that more than 3.5 per cent. is necessary.

An excess of casein is the most frequent cause of digestive disturbance in bottle-fed infants. The casein should never be more than 1 per cent. to begin with, and in most cases less than this will be found to give the best results.

The most certain indication of too large an amount of casein is the presence of curds in the stools. It must be remembered that free fatty acids so closely resemble curds as to deceive the naked eye. In such cases the stools are strongly acid, and they irritate the nates and genitals, causing erythema. These lumps of fat or fatty acids are soluble in ether, while the casein lumps are insoluble in that reagent.

Sometimes the child is unable to digest even a very small amount of casein.

We have already called attention to the importance of a proper relation between the percentages of albumin and casein. The addition of a small amount of egg-albumin to the food will sometimes assist in the digestion of the casein. If we attempt to correct the proteid indigestion by reducing the proportion of albuminoids, the child may suffer for want of nitrogenous food.

It is to be remembered that human milk contains nearly 2 per cent. of proteids, while colostrum, according to Pfeiffer, contains 9 per cent. of proteids on the first day after parturition, 7 per cent. on the second day, and 2.36 per cent. on the eighth day. Heubner gives the percentage of total proteids during the first week as from 2 to 3.2 per cent. Nearly the whole of these proteids is in the form of albumin and globulin, while the milk prepared at the milk laboratories contains but a trace of albumin. This large proportion of albumin to casein in human milk assists materially in preventing firm coagulation of the casein.

The term albuminoids in the above table might with propriety be changed to casein, for the reduced proportion is secured by diluting cow's milk, which contains about 0.5 per cent. of albumin. To reduce the casein to 1 per cent. the milk, and consequently the albumin, must be diluted three and a half times with water. This will reduce the albumin in such a mixture to 0.1 per cent.

If we wish to make the casein of cow's milk behave, on coagulation, like human casein, we must dilute the milk with five parts of water, thus reducing the casein to about 0.6 per cent. This proportion of proteid is too small to afford a proper amount of nitrogenous food for the child. Egg-albumin is sometimes used to supply soluble albumin to the milk foods. The author has seen good results from this addition to modified milk. Egg-albumin is slightly different in composition and properties from lactalbumin, and raw-egg albumin may not digest as readily as lactalbumin. Experience has not demonstrated the unfitness of fresh egg-albumin water as a diluent in modifying milk. We have already insisted upon the absolute freshness of the eggs used to furnish the albumin.

The objections to the use of centrifugal cream have already been stated.

We may repeat here the statement that a process for preparing an exact substitute for mother's milk has not yet been devised.

The Nursing Bottle. One of the most important points in artificial feeding is scrupulous cleanliness of bottle and nipple. The long rubber tube connecting the bottle with the nipple must be discarded, and the bottle itself should be as round and tube-like as possible, to avoid angles in which sour milk may collect. The nipple should be a simple rubber cone with several very small openings at the end. These openings should require suction on the part of the infant to bring out the milk. If, upon inverting the bottle, milk streams through the nipple, the latter is unsuitable for use; the fluid runs too freely into the infant's stomach, and indigestion is likely to result. Both bottle and nipple must be scalded after using, and when not in use be kept in a solution of boric acid in water, or some other mild antiseptic solution.

Amount and Frequency of Feeding. The amount of fluid to be given at each meal and the interval between meals are matters of great importance. Irregular and hap-hazard feeding should not be countenanced. The physician should direct these matters as minutely as possible, giving detailed directions as to the preparation of the food, its preservation until needed, the kind, size, and form of bottle, and the amount and time of feeding.

In breast-feeding the quantity of fluid taken is determined by the quantity secreted, and usually regulates itself. Sometimes, however, the amount secreted is too great for the needs of the infant, and at others it is not enough. In bottle-feeding the tendency is to feed too much and too often. Overfeeding is much more harmful than underfeeding, and is the most frequent cause of gastro-intestinal disturbance in bottle-fed infants. The capacity of the stomach in infancy is subject to considerable variation, but, as a general rule, the gastric capacity of a child during the first month is one-hundredth the child's body-weight—*i. e.*, the greater the weight the greater the gastric capacity. Numerous measurements of the stomach-capacity of infants, by different observers, as well as practical experience, have shown that the amount to be given at each feeding, the intervals between feedings, and the number of feedings in each day, are about those set forth in the following table. It must be understood, however, that these figures may need to be modified to suit individual cases:

Age.	Interval.	No. of feedings in 24 hrs.	Amount of each feeding.	Amount in 24 hours.
First week.	2 hours.	10	1 ounce	10 ounces.
1 to 6 weeks,	2 "	10	1½ to 2½ ounces.	15 to 21 ounces.
6 to 12 "	2½ "	8	2½ to 3½ "	20 to 28 "
3 to 6 months,	2½ to 3 hours.	6	4 to 5½ "	24 to 32 "
6 to 9 "	3 hours.	6	6 ounces.	36 ounces.
9 to 12 "	3 "	5	8 "	40 "

Gavage, or Forced Feeding. It becomes necessary at times to feed an infant, or even older children, by the forcible introduction of food into the stomach through a tube. Although this method of feeding has been practised for a long time in some European countries, its advantages have not until recently been fully appreciated in this country.

The method of practising gavage is very simple. The apparatus used is the same as that for stomach washing, and consists of a soft-rubber catheter, 12 to 16, American scale, or 24 French scale, a small funnel, two feet of rubber tubing, and a piece of glass tubing about three inches long to connect the rubber tubing to the catheter. The child is placed upon its back, the catheter is quickly introduced, the funnel raised so as to straighten the rubber connecting tube, and the food poured into the funnel. As soon as the food has almost all run down, the tube is pinched, to prevent the milk from trickling into the pharynx as the tube is removed, and it is then quickly withdrawn. The child should be kept absolutely quiet after feeding by this method. Should it offer much resistance to the introduction of the tube, the latter may be passed through the nose. In older children a mouth-gag is often necessary. If the food is regurgitated or vomited, the tube should be introduced a second time, and another feeding given. The intervals between feedings are generally longer when gavage is practised than under other circumstances. When this method is employed in feeding premature or feeble infants, the food should usually be predigested; if the mother's milk can be used this is unnecessary. It is well to wash the stomach before the first feeding, and at least once a day afterward while gavage is practised.

In connection with the incubator gavage has been found of great advantage in feeding premature infants; also after operations upon the throat and nose, and in other conditions in which the child may refuse food. The food is not often vomited when thus introduced, even when not retained in the usual method of feeding.

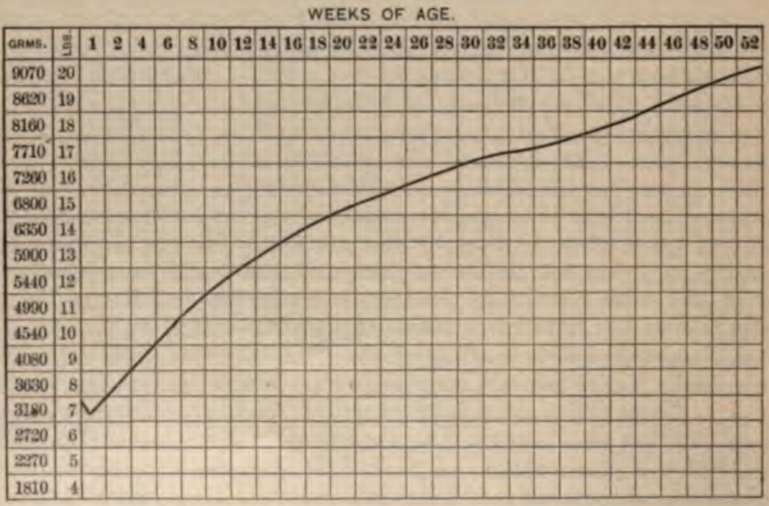
Signs of Normal Nutrition. The best index of the nutrition of an infant is the rate of increase in weight. The study of the child's nutrition requires frequent weighing. The weight of the average infant at birth is, according to J. Lewis Smith, seven pounds and four ounces for girls, and seven pounds and eleven ounces for boys. Others place the weight slightly lower, with less difference between the sexes. During the first three or four days there is a loss in weight of six to ten ounces, which is regained by the middle of the second week. A loss of twelve ounces, or a failure to regain the birth-weight by the beginning of the third week, at the latest, calls for careful investigation.

After the second week the weight should increase regularly, the child doubling its birth-weight by the end of the fifth month. While the rate of increase differs very considerably, a child that is not gaining five ounces a week cannot be said to be thriving as it ought. The accompanying chart, from Holt, shows the rate of increase in weight of the average well-nourished infant during the first year. (Fig. 215.)

The Feces. The character and amount of the stools of an infant often give an important indication of the quantity of food taken and the degree of digestion. They also give valuable information as to the cause of loss of weight and the character of the digestive disorder.

The stools of the new-born infant are greenish-black in color, and are termed meconium. Meconium is composed of intestinal mucus, bile, vernix caseosa, epithelium cells, hair, fat, cholesterin crystals, and calcium and magnesium phosphates. It is free from bacteria immediately after birth. On the third to the fourth day the stools change to a lighter color, and by the fifth day are lemon-yellow.

FIG. 215.



Normally the stools at this time are from three to four in twenty-four hours, smooth, semi-solid in consistence, nearly homogeneous in appearance, and have a slightly acid, not unpleasant odor. They contain fat, free fatty acids, calcium lactate, and a small amount of casein.

The reaction of the feces is usually acid, but is sometimes neutral or even alkaline. The cause of the acidity is the presence of fatty acids, lactic acid, and sometimes butyric. The degree of acidity varies considerably, yet excess of lactic and butyric acids may be considered pathological. The yellow color is due to bilirubin.

In diseased conditions the stools often become green, which color is usually attributed to biliverdin, but there is some doubt upon this point. Opposed to this idea is the fact that the stools are often yellow when passed, but become green on exposure to the air, while biliverdin on oxidation yields bilirubin, which is yellow and not green. In some cases at least the green color appears to be the result of fermentative processes, and to be caused by the excessive production of lactic acid and the action of this upon the biliary coloring matters.

There will usually be found with the green-colored stools more or less undigested casein, pseudo-nuclein, and free fatty acids. These appear as white masses distributed through the feces. Fat may be distinguished from casein by its solubility in a mixture of alcohol and ether.

The normal stool of a nursing infant contains about 85 per cent. of water, 2 to 3 per cent. of fat, 0.2 per cent. of proteids, and 0.1 to 0.2 per cent. of cholesterin.

Excessively acid stools often irritate the nates and genitals, producing a troublesome erythema.

The stools of infants fed upon cow's milk do not differ materially from those of breast-fed children, except that the amount is much larger, and they are more liable to contain caseous masses of large size, especially when sterilized milk is used.

Dry and pasty stools or an insufficient amount of fecal matter are often indications of a deficient supply of food. An excessive quantity of fecal matter is usually the result of overfeeding.

Starch will often be found in the stools of infants fed upon cereal foods. Its presence may readily be shown by its blue color reaction with iodine. Mucus is contained in the stools in catarrhal enteritis or intestinal infection. The stools of infants are sometimes offensive in odor. Such stools indicate proteid decomposition. This decomposition is usually caused by the excessive growth of the *Bacillus proteus vulgaris*. This bacillus is antagonized by the lactic acid ferment, *Bacillus lactis aërogenes*, and by the lactic acid produced by it. A variety of other micro-organisms are found in infants stools, such as the bacillus coli communis, micrococci, yeast-cells, etc.

A careful inspection of the stools should be made in all cases in which there is reason to suspect any form of digestive disorder.

CARE OF PREMATURELY BORN INFANTS.

Infants born before term require greater care than full-term children. Those born before the sixth month rarely if ever live. Of those born during the sixth month, a small proportion have sufficient vitality to survive, with proper care and attention. The prognosis will vary with the degree of prematurity and the development of the child. When but a few weeks are lacking to complete the full term, little extra care may be necessary. It is well, however, in such cases to omit the usual bath, apply a liberal coating of sweet oil to the skin, after washing the face, and use extra precautions to keep the infant warm. If the circulation is good and the cry vigorous, the child may be dressed; otherwise, it should be wrapped in cotton, and all exposure and handling deferred until later. In some cases the infant may be so feeble as to require the application of artificial heat to maintain its vitality. This will be indicated by cold and cyanotic extremities, feeble cry, and inability to nurse.

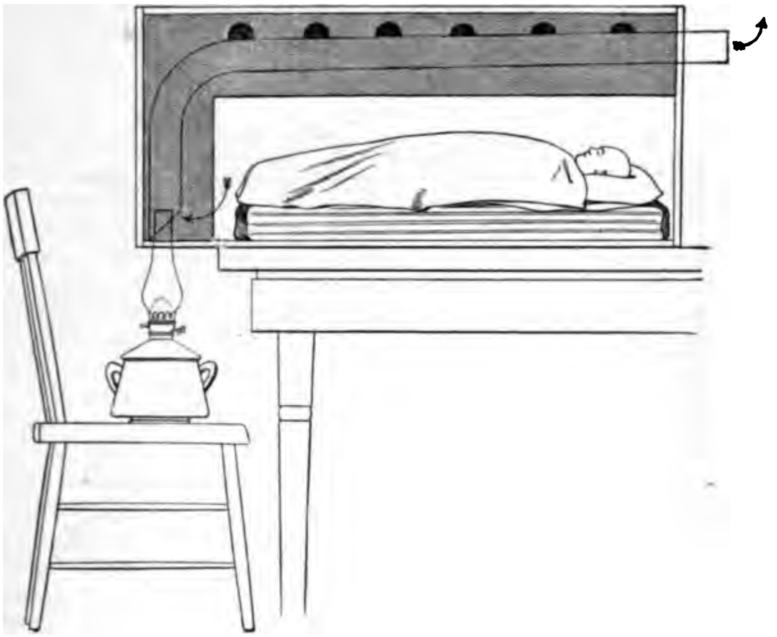
Incubators. Artificial heat may be applied by rolling the infant in blankets and placing a few bottles filled with water at a temperature of 105° F. in the blanket with it. A much better method is the use of an incubator. In private practice the physician may be called upon to improvise an incubator. It is a matter of the greatest importance that whatever measures are to be adopted to supply heat, they should be utilized as soon as possible. A simple, practical incubator may be constructed from a soap or candle box. Half-inch auger-holes are bored in the sides of the box about six inches above the bottom, and a pillow or other suitable bed is placed in the box, upon which the infant is laid, wrapped in cotton. The heat may be supplied by means of bottles filled with hot water and placed within the box.

The author has used an improvised incubator constructed as follows: There is required first a packing-box of suitable size, about 18 x 24 x 10 inches, and a piece of three-inch lead pipe, bent, as shown in Fig. 216. The longer arm of the pipe should be about the length of the box and the other a little shorter than its height. The end of the shorter arm is cut at an angle of sixty degrees. An opening is provided in one corner of the bottom of the box, larger than the pipe, and another in the opposite end near the top and at the corresponding side of the box. (Figs. 216 and 217.) The opening in the bottom of the box is covered with a plate of tin. The latter is provided with an opening large enough to receive the chimney of a kerosene lamp. The box is supported on two chairs, the pipe is put in place, with the long arm projecting an inch or two from the end of the incubator, and the short arm resting upon the tin plate covering the hole in the bottom. The pipe is protected by a piece of wire netting, folded over it and tacked to the side of the box. A series of auger-holes are bored near the top edge of the sides and at one end of the box, to admit air, and a glass plate is used to cover it. An ordinary kerosene lamp supplies the heat. The chimney of the lamp is passed through the hole in the tin plate, and well up into the pipe, so that no gases from the lamp can enter the box. The heat of the lamp creates a strong draught in the pipe, which not only carries off its own gases, but draws the air from the box through the open lower end of the pipe. The temperature of the air-chamber is regulated with a thermometer placed within by the side of the child. By raising or lowering the wick of the lamp the temperature can be raised or lowered, and can be adjusted to any desired degree. Moisture may be supplied to the air-chamber by hanging a wet sponge to the side of the box at any convenient place.

When once regulated it may safely be managed by any nurse, whether skilled or not. This is a matter of considerable importance in private practice.

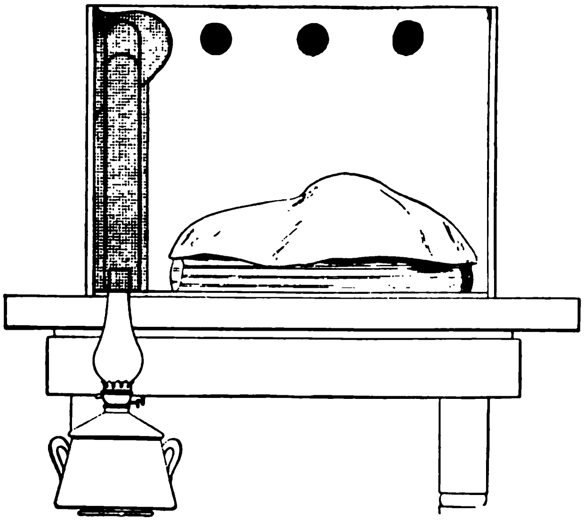
The temperature of the incubator for very feeble infants should be

FIG. 216.



Bartley's incubator. Longitudinal vertical section.

FIG. 217.

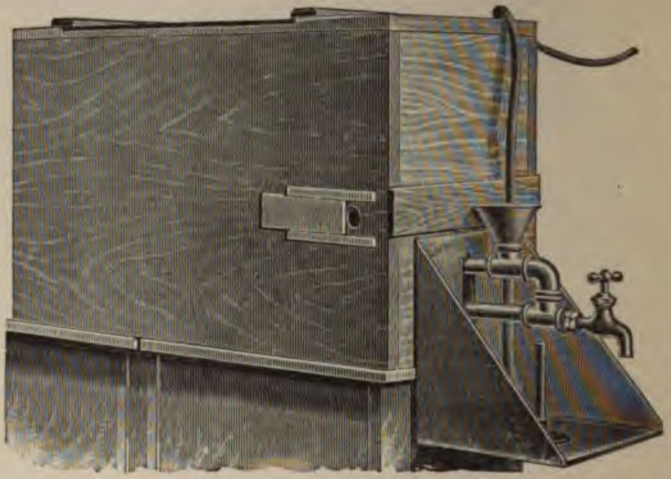


Bartley's incubator. Transverse vertical section.

kept at about 35° C. to 37° C., 95° to 98.6° F. For those a little stronger it may be from 30° C. to 35° C., 86° F. to 95° F.

An excellent incubator has been devised by Holt. (Fig. 218.) It a modification of Tarnier's apparatus, and is less complicated and le expensive than many others that have been described. It consists of double-walled box, thirty inches long, fifteen wide, and twenty high, wit

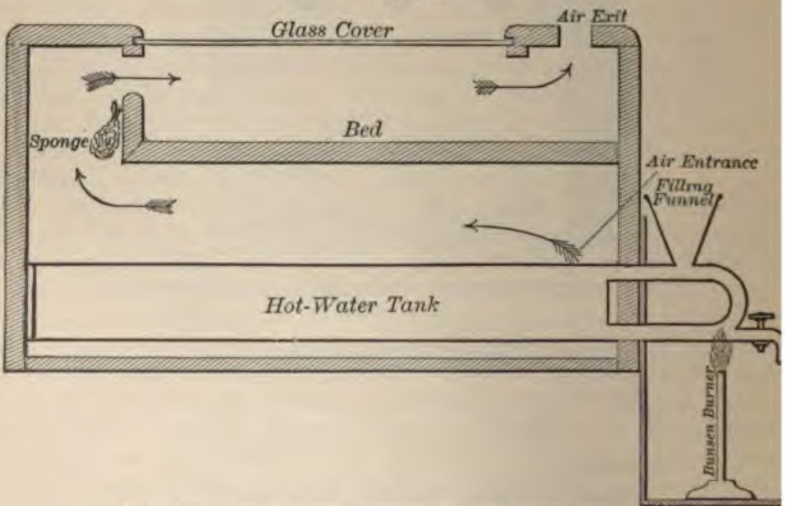
FIG. 218.



Incubator. (HOLT.)

a one-fourth inch air space between the inner and outer walls. A t of warm water, four inches deep and covering the bottom of the b supplies the heat to maintain the requisite temperature. A loop

FIG. 219.



Vertical section of incubator, showing internal construction. (HOLT.)

brass pipe is connected with one end of the tank, and this is provi with a funnel for filling and a faucet for emptying the tank. The w is heated by a Bunsen burner placed upon a shelf under the loop of pipe. The tank holds five or six gallons of water. Fresh air is admitted by four openings, three inches in diameter, two on each side of the box; a slide is so arranged as to regulate the admission of air at will. About six inches above the tank there is a shelf which serves as the support for the child's bed; a clear space of six inches is left at one end of the shelf. The air enters the openings above described, passes over the tank, then over a wet sponge and out at the top of the box. The internal construction is shown in Fig. 219. The top consists of a plate of glass, which may be pushed aside to admit of feeding the child without removing it from the incubator. The temperature is regulated by a thermometer. The infant lies upon a bed of cotton and enveloped in cotton. It is usually removed once daily for cleansing the chamber and renewing the cotton.

Holt says there is some difficulty in maintaining good ventilation with the room temperature at 75° F. or higher, but none at 65° to 68° F.

Rotch, of Boston, has devised a more complicated apparatus, but its expense is such that few will care to purchase it.

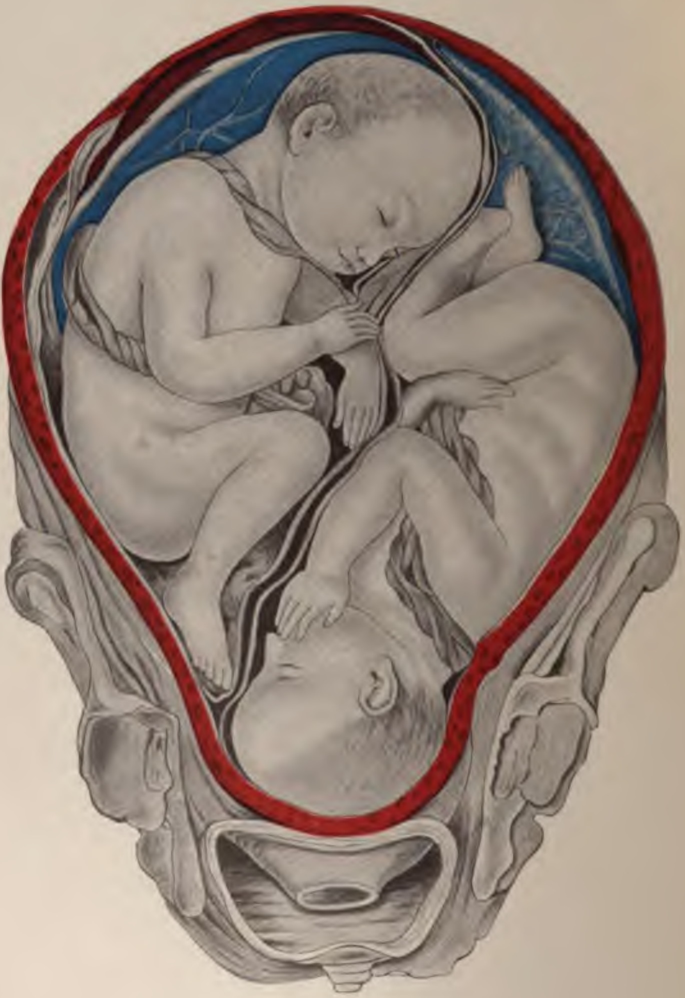
THE FEEDING of a premature infant will require special care. If left to itself it will not nurse from the mother, or from a bottle, in many cases. It may be necessary to feed it with a medicine dropper, giving the food frequently and in small quantity at a time. When breast milk is available, it should be pumped from the breast and given every hour or two. Or, for the first thirty-six hours after the birth, a 5 per cent. solution of milk-sugar, or freshly prepared whey, made from cow's milk by coagulating it with rennet and straining through muslin, as directed under Artificial Feeding, may be given. When breast milk is not available, whey may be exclusively given for the first week, and then it may be mixed with a little rich top milk, beginning with one-fourth rich milk, and gradually increasing this to one-third. When the child refuses to take sufficient food, as is frequently the case, gavage should be resorted to. A half-ounce of breast milk may be given every two hours to a seven months' child, and three-fourths of an ounce to an eight months' child.

The usual period of incubation is from one to three months, but must be subject to the judgment of the physician in the individual case. It will depend upon the circulation of the infant and upon its power to maintain its own body heat. When it is desired to discontinue the use of artificial heat, it is well to first gradually reduce the temperature of the incubator, day by day, to that of the room. It will usually be unsafe to dispense with the incubator until the child begins to gain weight and is able to nurse at the breasts or the bottle.

In many cases it will be advisable to keep the infant in the incubator until the period of full term has arrived. This, however, is not always necessary.

The habit of nursing may be cultivated by feeding through a nipple-shield.

PLATE XIX.



Uterus with Two-egg Twins. (After Smellie.)

PART V.

PATHOLOGY OF PREGNANCY.

CHAPTER XII.

MULTIPLE PREGNANCY.

By multiple pregnancy is meant the development of two or more embryos within the maternal organism at the same time. While, as a rule, this takes place within the uterine cavity (Plate XIX.), numerous cases are on record in which one embryo has found lodgement within the womb and another outside of it, combining uterine and extra-uterine gestation.

The reason for the occurrence of multiple fœtation is not known, but speculation has given rise to many theories, the most plausible of which is that the condition is one of atavic manifestation. In its etiology the influence of heredity, especially on the mother's side, is well established, but instances of a paternal bias are not wanting. Conditions, such as climate, environment, and the like, appear to have little effect in determining plural conception, yet in certain localities plural pregnancies occur with much greater frequency than in others.

Rumpe found that in twenty-nine cases of single-egg twins the mothers were under twenty-five years of age in 70 per cent., and in one hundred cases of two-egg twins the mothers were between twenty-six and thirty in 50 per cent.

Frequency. Twin conception is more frequent in women who have already borne children, and more so in old than in young primigravidæ. Of multiple pregnancies the commonest variety is *twins; triplets* more rarely occur. *Quadruplets*, and even *quintuplets*, are met with exceptionally. Reported instances of a larger number of embryos developed simultaneously in the same woman have not been sufficiently authentic to merit credence. According to G. Veit, in 13,000,000 births, twins occurred once in 89, triplets once in 7910, and quadruplets once in 371,126 labors. For this country these figures may be accepted as approximately correct, though recent statistics from two of the largest Eastern cities place the proportion of twins at one in every 120 labors, while Green found three cases of triplets among 5626 labors (one in 1875) in the records of the Boston Lying-in Hospital.

Mode of Origin. Twins may arise (1) from a single ovum, the germ dividing, (2) from two separate ova developing in the same Graafian follicle—rarely,[1] (3) from two ova extruded from different portions of the same ovary, or (4) from two ova each proceeding from a different ovary. Triplets arise from three distinct ova, or from one-egg twins and a single ovum, while quadruplets come from double twins, or from twins and two single ova.

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[1] While in the ovaries of the new-born child, and especially of the unripe fœtus, a Graafian follicle is sometimes seen to contain two, three, or even four ova (Pantellani), Waldeyer states that in the adult human ovary he has never found more than a single ovum in a follicle.

Of twins those developing from two distinct ova are the most frequent, and the combined average weight of such children is greater than in the case of single-egg twins, while the difference in weight of the individual gemellus is more marked in the latter instance. This is probably due either to nutritive causes or to the inherent weakness of a divided germ.

Sex of Twins. Veit found that of 150,000 twin pregnancies in rather more than one-third both children were males, in less than one-third both were females, and in the remaining third both sexes occurred. The more recent statistics of Rumpe show that of 65 single-egg twins, both children were males in 36, and both females in 29, and of 101 two-egg twins, in 31 both were males, in 16 both were females, and in 54 each sex was represented. This indicates that in about 66 per cent. of twins both children are of the same sex, with the proportion of males largely in excess.

Arrangement of Membranes. The arrangement of the membranes in twin conceptions depends upon the origin of the embryos. The decidua vera is always single; the reflexa is single for one-egg twins, and double when two ova become attached at different portions of the uterine surface.[1] The chorion is, also, always single when two embryos develop from the same egg, and double when two ova are involved. The amnion, an individual product, is probably always primarily double. Where two embryos occupy a common amniotic sac, the median wall, which originally separated them, may undergo absorption, but careful search will generally reveal some vestige of its former presence.

The Placenta. As the embryonic portion of this organ is always of individual origin, it follows that in all cases of twin pregnancy the placenta is at first double. But the close proximity of the two structures in one-egg twins usually leads to fusion of their contiguous edges, with subsequent deep and superficial anastomoses of the bloodvessels; while in two-egg twins, although a widely distant implantation of the placentæ may result in their permanent separation, very frequently their borders will be found to have become united, with an easily recognizable intermediate zone lying between. Whenever two chorions are developed anastomosis of the placental vessels does not take place. *Placentæ succenturiatæ* (separate or accessory lobes) occur with frequency in twin pregnancies, as well as anomalies in the insertion of the placental end of the cord.

The individual growth of twin embryos varies greatly, according to the proportion of blood supply furnished to each. Any interference with the circulation in the one—whether resulting from imperfect attachment, early partial separation from accidents to the placenta, anastomotic complications in joined placentas, inherent feebleness of the embryo, disorders of the membranes or the like—immediately acts to the advantage of the other; the latter, by its more rapid development and augmented strength, the expansion of its envelopes and increase of the surrounding liquor, soon acquires such supremacy over its fellow that this eventually perishes, and is either compressed and flattened against the uterine wall as a *fœtus papyraceus*, degenerates into a mole, or is prematurely cast off from the uterine cavity; the fortunate individual, on the other hand, continues to advance to the completion of gestation. It is estimated that the intra-uterine death of one embryo occurs with three times greater frequency in one-egg twins than in those developed from two separate ova, a circumstance readily accounted for by the fact that malformations and pathological conditions are much oftener met with in the former than in the latter.

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[1] A single reflexa may exist where two ova are situated very near together.

Superfœtation. In rare instances it has happened that the atrophied body of the dead fœtus has been retained in utero for a considerable time after the expulsion of the living child at term. Occasionally, instead of perishing, the growth of the feebler embryo may be retarded only by the more rapid and vigorous advancement of the brother, and, after the delivery of the latter, may continue its intra-uterine existence for a period of weeks or even months until its development is completed. The fact of such a delivery following at an indefinite interval after the expulsion of the first child has led to belief in the possibility of superfœtation as opposed to superfecundation.

Superfecundation. By the latter term is understood the fertilization of more than one ovum, discharged at the *same* ovulation, by separate acts of insemination at short intervals, while superfœtation implies the impregnation of an ovum during such time as another ovum from a *previous* ovulation is in process of utero-gestation. While superfœtation is theoretically possible, it has not been proved.

Pathological Character. Possibly owing to the excessive distention of the uterus as much as to other causes—hydramnios being a frequent accompaniment—there exists a marked tendency in plural pregnancies to an early termination of gestation, and miscarriage and premature delivery are particularly liable to result in cases of one-egg twins, quadruplets, and quintuplets.

Both children in twin pregnancies may be expelled at the same labor, or at intervals ranging from eighteen to twenty-four hours, or even longer, as already mentioned. The offspring of plural pregnancies are often of feeble vitality, and one child is quite likely to succumb within a comparatively short time following delivery. Monstrosities are much more liable to be developed under these conditions, and the mothers are more prone to eclamptic attacks than when the pregnancy is simple.

Diagnosis of Multiple Pregnancy.

The existence of twin pregnancy may, as a rule, be determined with reasonable certainty by the following data: (*a*) Excessive size and tension of the abdomen are significant of twins. (*b*) Permanent uterine tension with very limited mobility should suggest multiple fœtation. Persistent tension is present in simple hydramnios, but here there is preternatural mobility of the fœtus. It also occurs in the concealed form of accidental hemorrhage, but the latter condition is distinguished by its shorter duration and by the signs of internal hemorrhage. (*c*) The abdominal tumor is usually broader than in single fœtation. Sometimes the abdomen presents a sulcus corresponding to the space between the two fœtuses; but this may arise from other causes. (*d*) Detection by abdominal palpation of two fœtal heads, or of two dorsal planes, of three or four fœtal poles, or of a multitude of small parts is usually possible. (*e*) Detection of one head in the excavation and one in the upper uterine segment makes the diagnosis of twins. (*f*) One head may be found in the excavation and one in an iliac fossa. (*g*) Distance from pelvic pole to fundal pole more than 30.5 cm., 12 inches, is evidence of twins. (*h*) The recognition, by auscultation, of two fœtal heart-sounds, not synchronous, and heard at different locations, is conclusive. It must not be forgotten, however, that one fœtus may be dead. Even when both are living the detection of two independent heart-sounds is frequently impossible. (*i*) Suprapubic œdema is almost invariably present in plural pregnancy. This, however, may occur in single pregnancy with hydramnios, since it arises from venous stasis in the abdominal wall due to pressure brought about by the greatly distended uterus.

Vaginal Signs. During pregnancy twin fœtation presents practically no characteristic signs obtainable by the vaginal examination. In course of the labor one or more of the following conditions may be detected. (*a*) Rapidly successive presentation of a head and a breech. (*b*) Four extremities presenting. (*c*) Two amniotic bags offering at the cervix.

The diagnosis of triplets is sometimes possible after the pregnancy has reached the later months. In quadruple pregnancy the existence of multiple fœtation should be capable of recognition, but the number of children can scarcely be determined before birth.

Management of the Labor. The usual risks of labor for both mother and child are somewhat increased in twin births. The labor is frequently longer and is more likely to be complicated than in single fœtation. Owing to overdistention, the uterus may retract less promptly in the third stage, and the danger of post-partum hemorrhage is greater. The viability of the child is less than in normal gestation. In nearly 25 per cent. of cases the labor is premature. These facts must be borne in mind in the management of the labor and the after-care of the children.

According to the statistics of Kleinwächter and of Speigelberg, in 50 per cent. or more of twin births both fœtuses present by the vertex. Breech and transverse presentations are more common than in ordinary labors.

When the first child is larger than the second, the second birth, as a rule, is rapid. The delivery of the second fœtus is rarely delayed more than a few hours. The cord of the first child should be ligated on the maternal as well as the fœtal side, owing to the possibility of communication between the placental circulations. The membranes of the second fœtus may be ruptured as soon as labor pains are resumed after expulsion of the first.

Interference in either delivery must be governed by the same rules as in single births.

Both placentas are usually expelled together after the birth of the second child. Very rarely, when the placentas are entirely distinct, the first one may come away before the expulsion of the second fœtus.

Special care will usually be required by manipulation and the use of ergot to secure full retraction of the uterus.

In triple births the management is, in general, the same as in twins.

CHAPTER XIII.

ANOMALIES AND DISEASES OF THE FŒTAL APPENDAGES.

DISEASES OF THE DECIDUÆ.

Inflammation of the Decidual Tissues. As the decidua is merely the hypertrophied and modified mucous membrane of the uterus, we find it the seat of the same inflammatory processes as occur in the endometrium of the non-pregnant. Decidual endometritis may be either acute or chronic.

Acute Decidual Endometritis. This form of the disease is much less commonly met with than the chronic, and may be associated with some acute infectious disorder, as variola; or it may be the consequence of unskilled attempts at inducing abortion. The pathologic features are swelling, congestion, and infiltration of the tissues with leucocytes: the course of the pregnancy usually is cut short by the disease.

Chronic Decidual Endometritis. The causes given for this affection are a pre-existing endometritis, especially of syphilitic or gonorrhœal origin, and death of the fœtus with retention of the ovum; but there are many cases in which no satisfactory explanation can be offered. Three types of the affection are described:

A. Chronic Diffuse Decidual Endometritis. This form is characterized by a general hyperplasia, so that the decidua becomes enormously thickened: there is an increase in the amount of connective tissue and subjacent muscular fibres, together with proliferation of the decidual cells. The vessels are enlarged and extravasations of blood are numerous. If the disease develops early in pregnancy, abortion is the usual result; but when the process pursues a slow course and is not pronounced, the term of gestation may be completed. In such a case there may, however, be difficulty in the separation of the membranes at labor; the placenta may be adherent and require manual extraction, or some thickened portion of the decidua may remain in utero and give rise to septic trouble.

B. Chronic Polypoid Decidual Endometritis. This type is the result of an uneven distribution of the hyperplastic tissue, so that excrescences, rounded or polypoid, are produced. This form of the disease usually occurs early in pregnancy, with the result of destroying the fœtus and bringing on abortion.

C. Catarrhal Decidual Endometritis. In this variety the prominent features are the involvement of the glandular tissues and a hypersecretion of watery mucus. If associated interstitial changes block the outlet of the glands, cysts may be formed; but usually the secretion escapes from the uterus, and gives rise to a symptom known as hydrorrhœa gravidarum.

Hydrorrhœa Gravidarum. The discharge from the uterus may vary in amount from a few drops to a pint, and occur at irregular intervals. The secretion finds its way between the membranes to the os, and escapes almost continuously, provided there be no obstruction. If there be adhesions between the chorion and decidua, the fluid may accumulate until the pressure becomes great enough to overcome the resistance, when it escapes in a profuse gush. Hydrorrhœa may be present from the early weeks of pregnancy, but usually it is a symptom not marked until the late months. The fluid is clear, slightly viscid, and contains albumin: spots upon the clothing frequently show a pinkish tinge at the margin. In diagnosing this affection it must be remembered that certain non-gravid conditions, as cancer and fibroid, may produce a watery discharge; and when there is no doubt about the existence of pregnancy we should be sure that the fluid comes from the uterus, and is not the remains of vaginal douches or the result of incontinence of urine. When the source is clearly the pregnant uterus it may be difficult to decide whether the fluid comes from diseased glands or from the amniotic sac through a small opening high on one side. Rupture of the membranes is diagnosed by finding that the fluid contains urea and flakes of vernix caseosa; its escape does not continue over a long period of time, but is followed by abortion or premature labor.

PROGNOSIS AND TREATMENT. Hydrorrhœa deciduale may produce no untoward results for either mother or child; in a few cases uterine contractions appear, and probably are the result of the endometritis of which the discharge is a symptom. Rest and uterine sedatives are the only treatment which seems to be effective, although in a few cases potassic iodide has been favorably mentioned.

Atrophy of the Decidua. This is a rare condition described by a few writers. Its result is that the ovular attachments are so imperfect that the ovum hangs down in the uterus and may come to lie in the cervix. Fœtal death and abortion are the usual terminations.

ANOMALIES AND DISEASES OF THE AMNION.

Because we are still ignorant of the sources of the liquor amnii as a physiologic secretion but little is known of the causes which produce variations in the amount. Many modern authors consider this fluid of purely fœtal origin, coming from the kidneys and skin, as well as transuding from the vessels in the cord. Other writers believe the maternal organism aids in its production, there being a transudation through the chorion and amnion from the blood-current of the mother. Probably both mother and fœtus contribute to its production. The normal quantity at term is estimated at one or two pints.

Oligohydramnios, or Deficiency of Amniotic Fluid. The causes of this condition are unknown, but the results may be pronounced. The fœtal parts are apt to come in contact with one another and with the inner surface of the amnion; fœtal movements are therefore restrained, or they may result in the formation of ulcers from friction. If the uterus is closely applied to the body of the fœtus, adhesions may form between its surface and the amnion; this relation tends to the production of deformities and the development of amniotic bands, a condition to be described later. Ballottement is impossible, and it is difficult to map out the fœtus by palpation: the first stage of labor is slow, owing to the deficient bag of waters. Oligohydramnios seldom can be diagnosed, and is beyond the reach of treatment.

Hydramnios, Polyhydramnios. This condition is characterized by an excess of liquor amnii, and often is spoken of as a dropsy of the amniotic sac. The minor degrees of increase are apt to be unnoticed, and we do not use the term hydramnios until the fluid is large enough in amount to produce symptoms. Statistics as to the frequency of this affection are unreliable from the fact that some patients are more tolerant of distention than others; multiparæ, for instance, would be less likely to complain than primiparæ. The marked forms of the disease probably do not occur oftener than once in 150 or 200 confinements. In extreme cases the accumulation of fluid may amount to five or six gallons.

ETIOLOGY. Uncertainty as to the sources of the liquor amnii has led to the promulgation of many theories concerning the causes of hydramnios; we shall mention some of the leading ones.

A. Fœtus. 1. *Number.* Hydramnios is frequently found associated with twin pregnancies, and the cause is supposed to be the relation of the vessels in the common placenta. If the vessels of one twin take a shorter course, more blood would go to that fœtus than to the other. The result is more rapid growth and a larger, more powerful heart. Thus, one child absorbs more fluid from the placenta and produces excessive secretion, certainly from the kidneys and possibly from the skin. The accumulated discharges cause the hydramnios. In other cases one twin may exert pressure upon the other in such a way that there are stasis in the vessels of the cord and increased transudation through their walls.

2. *Malformations.* These often are associated with hydramnios, but it is impossible to say whether as cause or effect.

3. *Health of Fœtus.* Syphilis seems to be a cause in some cases, especially any syphilitic affection of the liver which raises the blood-pressure in the umbilical vein and leads to increased transudation. The fœtus may be dead and macerated, but this condition may be the result of the hydramnios. It is only fair to say that in 100 cases of hydramnios Bar found 44 per cent. of the children to be in good condition.

B. Fœtal Appendages. When the accumulation is very rapid an inflammation of the amnion has been suggested as an explanation. Such conditions as twisting and other anomalies of the cord raise the blood-pressure in the vein and seem to account for some of the cases. Diseases of the placenta and decidua should be mentioned under this head.

C. Mother. Syphilis, albuminuria, and cardiac disease are given among the maternal conditions producing hydramnios. It is said that there are cases in which excess of liquor amnii is associated with serous effusion elsewhere. Hydramnion is almost twice as frequent in multiparæ as in primiparæ.

SYMPTOMS. The symptoms may be present from the beginning, but usually do not appear before the fifth month. The disease may take a chronic or an acute course.

The Chronic Form. This is the type more frequently seen: the enlargement of the uterus produces (1) reflex disturbances, (2) pressure-effects, and (3) certain alterations in the signs of pregnancy.

1. *Reflex Disturbances.* Nausea and vomiting may be early symptoms, and result in emaciation and weakness from want of nourishment.

2. *Pressure-effects.* The patient has a feeling of distention which often amounts to severe suffering; the pains sometimes are intermittent like labor-pains: there may be marked œdema of the lower extremities quite early in the course of the pregnancy, so that locomotion becomes difficult; even in the sixth month pressure upon the diaphragm may cause dyspnœa and palpitation; there may be albuminuria and jaundice. All those phenomena of pregnancy which we ascribe to increase of intra-abdominal pressure are much intensified and appear early.

3. *Alterations in the Signs of Pregnancy.* On abdominal palpation the fundus is found at a much higher level than corresponds with the period of gestation; the uterine walls seem unnaturally thin and in a state of permanent tension; fluctuation may be obtained earlier than is usual, and is more pronounced than in normal cases; the fœtal parts can seldom be differentiated, but if the child can be felt ballottement is abnormally marked. On auscultation the fœtal heart-sounds are muffled or unheard. On vaginal examination the motility of the fœtus is excessive; the lower segment is greatly stretched and the cervix partially effaced and somewhat open, as if the first stage of labor had begun; but the lips of the cervix are not so tense and thinned as in labor. Malpresentations are not uncommon, and the labor is apt to be premature.

The Acute Form. In this form the excessive accumulation may take place in the course of a few days and rapid distention cause great suffering: in some cases a rise of temperature occurs. There is so much sensitiveness of the abdomen that without an anæsthetic palpation frequently is impossible.

DIAGNOSIS. When there is a history of irregular menstruation and the small size of the fœtus or thick abdominal walls render palpation difficult, the existence of pregnancy may be overlooked, so that hydramnios may be mistaken for ascites or ovarian cyst. In ascites the surface of the abdomen is flattened; the flanks bulge and are dull on percussion; there is resonance over the central part of the abdomen; a change in the woman's position alters the relation between the dull and resonant areas. Both hydramnios and cyst present signs quite the reverse of those just mentioned. If, by placing the hands over the tumor, there are felt alternating contractions and relaxations (Braxton Hicks's sign), we can exclude ovarian cyst and be quite certain that we are dealing with the distended uterus; when these signs are wanting we may be obliged to introduce the finger into the cervix as far as the internal os and feel for the bulging membranes. In acute cases the symptoms of hydramnios closely resemble those of ovarian cyst with torsion of the pedicle, and it may be necessary to dilate the uterus, or even to perform abdominal section before a diagnosis is established.

Having established a diagnosis of pregnancy, we must distinguish an acute hydramnion from ectopic gestation, or be certain that the distention of the abdomen does not come from some associated condition. Ectopic pregnancy is distinguished by the cardinal signs of pain, irregular flowing, and the presence of a tumor beside the enlarged uterus. In pregnancy complicated by ovarian cyst a thorough examination will result in the discovery of a second tumor.

In the light of the positive evidences of pregnancy we must decide whether the distention of the abdomen is due to hydramnios, twins, or hydatidiform mole. In twins the fœtal parts are easy to palpate and their multiplicity is evident; there are two separate areas over which the heart-sounds are heard; fluctuation is not a feature nor is ballottement marked. Hydatidiform mole is characterized by a peculiar discharge from the uterus, and will be described later.

Prognosis. The prognosis for the child is poor, as in many cases the fœtus is diseased; and even when the child is healthy the frequency of premature labor diminishes its chances of living. The degree and rapidity of distention affect the prognosis, which, of course, is worse in the acute form, in many chronic cases there being nothing more than discomfort. The prognosis for the mother is less favorable than in normal cases, because the overdistention may permit malpositions requiring operative interference, and the stretched muscular fibres may not contract well in the third stage, thus making post-partum hemorrhage a decided danger. There also are risks incident to abortion and premature labor, such as infection and subinvolution. The increased pressure on the abdominal organs predisposes to toxæmia with all its resulting evils.

Treatment. Medical treatment is of little value, except the antisyphilitic in a few cases: a milk-diet is recommended for its diuretic action. In some cases an abdominal bandage gives relief. Whenever possible the case should be carried along until the fœtus has reached a viable age, the patient being under the constant supervision of a physician, who must make frequent urinary examinations and adopt prophylactic measures against toxæmia. Labor should be induced in acute cases, and in those chronic ones in which there is danger from the excessive distention. After puncture of the membranes the fingers should partially plug the vagina to prevent the too rapid escape of the waters, and thus avoid malpresentation and syncope. When the overdistention prevents the proper action of the uterine fibres the membranes should be ruptured at the beginning instead of at the end of the first stage; the time selected for the puncture should be between the pains. The second stage of labor may be marked by violent contractions, and the third by muscular atony, so that all the preparations for the control of post-partum hemorrhage should be made in advance.

Alterations in the Character of the Amniotic Fluid. The appearance of the liquor amnii varies with the period of pregnancy: in the early months it is clear and transparent, alkaline in reaction, and with a specific gravity of about 100.6. Later, the fluid becomes somewhat thicker and whitish from the addition of epithelial cells and flakes of vernix caseosa; the liquid also contains small hairs from the surface of the fœtal body and shows traces of urea. Substances injected into the maternal circulation may reach the liquor amnii, and in cases of poisoning by the mineral salts their traces have appeared in the amniotic fluid. At term more or less meconium may be mixed with the fluid, giving it a dark-brown or greenish tinge. The death and maceration of the fœtus may give a pinkish coloration to the liquor, or it may become thick and dark, with a fetid odor. Infection of the amniotic sac may cause putrid decomposition of its contents, and may come about in either of two ways: there may be a small rupture of the membranes, high up at one side, where micro-organisms may enter, but through which the sac cannot entirely empty itself; or a severe and long-continued infective disease of the mother may lead to infection of the fœtus and subsequently to that of the amnial liquor.

Amniotic Bands. These probably are the result of adhesions between fœtus and amnion, being particularly favored by deficiency of the liquor amnii; later, the distention of the uterine walls draws out the adhesions into bands which may be simple or branching. Sometimes the bands rupture during this process, and one end is found floating free while the other is attached to either skin or amnion. Either the adhesions or the bands may make so much traction upon that portion of the child to which they are attached that deformities and the death of the fœtus result: premature detachment of the placenta may be caused by the pulling of short bands. In some cases the bands encircle a limb and produce amputation, an injury which has been wrongly ascribed to the action of a coil formed from the umbilical cord.

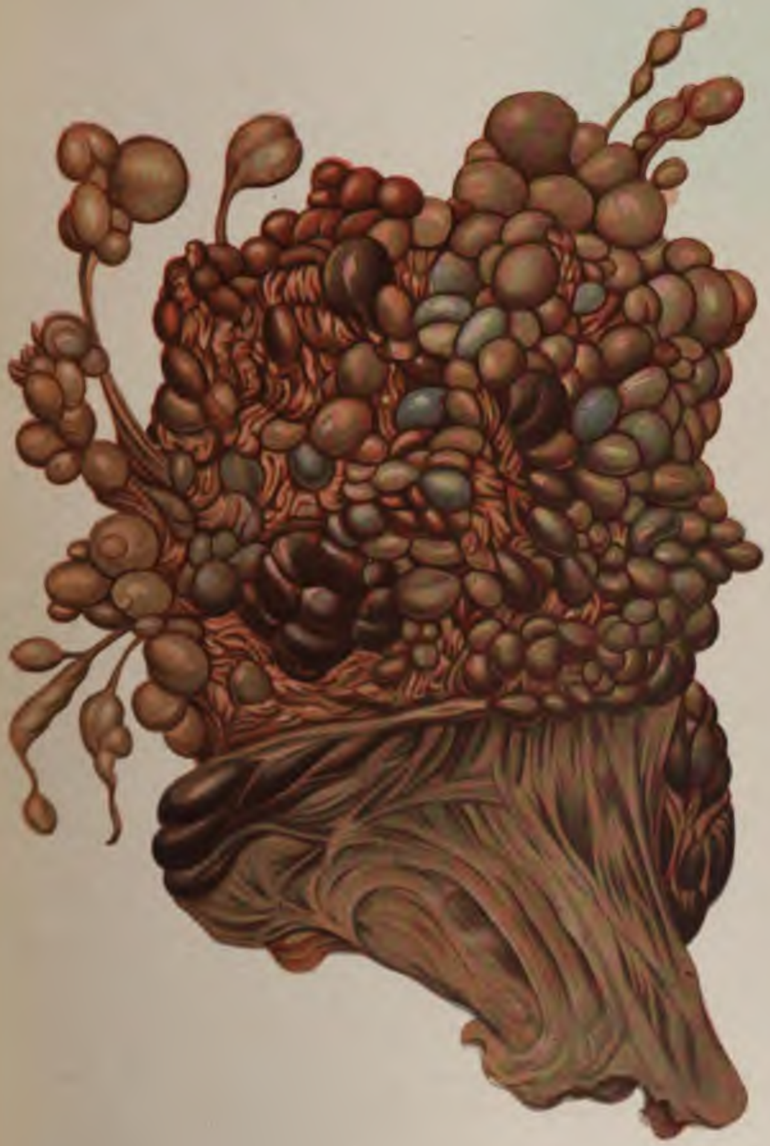
DISEASES OF THE CHORION.

Myxomatous Degeneration of the Chorion. This disease is commonly known as hydatidiform or vesicular mole, and is rather rare, occurring about once in one or two thousand cases. The affection consists of proliferative degeneration of the chorionic villi, resulting in the formation of cysts, most of which vary in size from that of a millet-seed to that of a grape, although a few reach the size of hens' eggs. The pedicles of these cysts consist of the trunks and branches of the villi, so that the arrangement suggests that of a bunch of grapes. (Plate XX.) On close examination, however, it may be seen that some cysts spring from the walls of others and that there are several on a single stem, the intermediate constricted portions often being patulous, so that fluid can be forced from one cyst to the next. The vesicles themselves are rounded, fusiform, or pyriform, and are distended with a clear, yellowish or pinkish fluid of watery consistency and containing albumin and mucin.

In some cases the aggregation of cysts may form a mass as large as a child's head and be covered and infiltrated with blood-clots. A smaller neoplasm may be expelled wrapped in a decidual layer, which must be incised before the cysts appear. On laying open a vesicular mass all traces of fœtus and amniotic sac may be wanting, or there may be a collection of gelatinous fluid in which only the remains of a fœtus or umbilical cord are found. In other cases, particularly when all the villi are not affected, the fœtus may be present, its development corresponding to the period of pregnancy at which its death occurred.

PATHOLOGY. When the entire chorion is involved the disease is classed as complete, and such is the usual form when the degeneration begins early in pregnancy. If the affection does not begin until there has been some atrophy of the villi, we have the partial variety, which usually is confined to the neighborhood of the placental site. The extent of the chorion involved determines the fate of the child, there being cases in which only a few cotyledons of the placenta are diseased and the child's health unaffected.

PLATE XX.



VESICULAR MOLE

There is some discussion as to the pathologic *rôle* played by the different tissues of the villus. A normal villus consists of a stroma made up of mucoid tissue continuous with that in the umbilical cord; upon this are two layers of cells, of which the outer comes in contact with the decidua, and is known as the syncytium. Virchow considers hydatidiform mole to be the result of hypertrophy and degeneration taking place in the stroma of the villus, *i. e.*, it is a myxoma of the chorion. While the majority of writers seem to agree with Virchow, several recent French and German observers have called attention to changes in the cell-layers, and throw considerable light upon the mode of behavior of certain of these neoplasms. L. Ouvry states that there are marked proliferation and degeneration of the cellular layers, so that upon the walls of the larger cysts may be seen bud-like outgrowths made up of the elements of the syncytium and deeper layer; where the vesicles come in contact with the uterine walls these processes are more pronounced than in the depths of the neoplasm. There are other investigators who go so far as to say that the morbid processes are confined to the cellular coverings of the villi.

Vesicular Mole and Malignancy. In most instances the mass of degenerated villi is limited by the decidua and uterine wall, but, even in small moles, it is not uncommon to observe that the decidual envelope has been thinned in spots by invasion of the vesicles. Cases have been reported in which the muscular tissue of the uterus was eroded and large vessels penetrated, so that fatal hemorrhage followed removal of the mole; also uterine rupture and fatal peritonitis have been known to be produced by the presence of the neoplasm. It is pretty generally admitted that deciduoma malignum springs from syncytial cells remaining in utero, and hydatidiform mole is now recognized as one of the most potent predisposing causes. Veit maintains that there is some unknown pathologic condition connected with pregnancy underlying both vesicular mole and deciduoma malignum. Thus, there seem to be both benign and malignant moles, and the majority of the cases of deciduoma malignum have a previous history of vesicular mole.

ETIOLOGY. The causes of vesicular mole are not known; both a fœtal and a maternal origin have been suggested, but the weight of authority at present seems to incline toward favoring a maternal causation, considering the death of the fœtus as secondary. Syphilis and tuberculosis are mentioned among the predisposing causes. Virchow considers the primary factor to be disease of the decidua. In most cases the mother is a multipara and over thirty years of age.

SYMPTOMS. The symptoms usually show themselves before the tenth week, and, associated with the evidences of pregnancy, there may be the following signs:

A. Bloody Discharge from the Uterus. This is the most common sign, being present in two-thirds of all the cases. The hemorrhage appears without warning, and is frequently repeated: each attack of flowing usually is followed by a pinkish, watery discharge of fetid odor.

B. Disproportionate Size of the Uterus. When the disease is of the complete variety the uterus may be much larger than corresponds with the period of pregnancy; but although the uterus may be as large as at the fifth or sixth month, no evidence of the presence of a fœtus can be obtained either by palpation or auscultation. The increase in size may be rapid, and the uterus then remain stationary, owing to the death of the fœtus; when the degeneration is partial there may be no increase of size.

C. Change in the Physical Characteristics of the Uterus. In well-marked cases the uterus may have a doughy feel, and occasionally its outline is irregular.

D. Discharge of Vesicles. This is a pathognomonic sign, but, unfortunately, rarely is present until the process of expulsion has begun.

The almost constant drain from the uterus produces marked anæmia and debility; pressure may cause hepatic and renal insufficiency, and there may be considerable abdominal pain. Frequently the general aspect of the patient suggests the presence of malignant disease.

PROGNOSIS.—For the child the outlook is very dark, both on account of impairment of nutrition and its early expulsion; it is very rare for a large mole to be retained beyond the sixth month. There are several instances recorded in which, in a twin pregnancy, only one chorion was affected and one child was delivered viable. For the mother the dangers are hemorrhage and infection, as well as the possibility of uterine rupture or subsequent malignant disease. In some cases portions of the mole have remained within the uterus during many months, giving rise to repeated hemorrhages, and rendering the patient liable to septic infection. When the disease is so slight that the health of neither mother nor fœtus is affected the question of prognosis does not come up, as the diagnosis is not even suspected.

DIAGNOSIS.—Until the stage of expulsion the diagnosis of hydatidiform mole may be extremely difficult, owing to the absence of signs of pregnancy. The enlarged uterus, together with irregular flowing and a cachectic appearance, suggests the presence of an intra-uterine tumor; this is particularly the case when the symptoms develop near the period of the menopause. Exploration of the uterus may be necessary before the diagnosis can be made. If the diagnosis of pregnancy is clear, hydatidiform mole must be distinguished from hydramnion, twins, and normal pregnancy with symptoms of threatened abortion. In hydramnion the symptoms do not belong to the early periods of pregnancy, and fluctuation or ballottement may be obtained, although it must be remembered that in both affections all evidences from the fœtus may be wanting. Twin pregnancy has nothing in common with vesicular mole except the uterine enlargement; as abortion is common in cases of mole, only the progress of events will show the condition of the ovum, unless through the dilated cervix some of the cysts may be felt. More Madden states that before the fourth month it is usually impossible to differentiate myxomatous degeneration of the chorion from a normal pregnancy.

TREATMENT.—When the diagnosis is established the indication is to empty the uterus at once, for the chances of saving the child are so extremely small that it is unjustifiable to expose the mother to further risk. The cervix may be dilated with steel dilators or the Barnes bags, and then the finger, aided by the long-handled abortion forceps, should be used for the removal of the neoplasm. In some cases the entire hand is introduced within the uterus, but the danger of rupturing a thin wall must be remembered, and all intra-uterine manipulation must be gentle. It is a good plan to make counterpressure over the abdomen while working within the uterus. As the great danger is hemorrhage, which cannot be controlled until the uterus is firmly retracted, the cysts must be cleared out rapidly, followed by the use of hot irrigations and hypodermatic injections of ergot. The curette is a dangerous instrument, as it may readily perforate the uterine tissues; but its use is sometimes necessary when the cysts are imbedded in the decidua, for thorough removal undoubtedly diminishes the risk of subsequent deciduoma malignum. The liability to septic infection calls for strict asepsis, during the abortion as well as afterward.

ANOMALIES OF THE PLACENTA.

At the end of pregnancy the placenta is an oval-shaped mass measuring two to three centimetres in thickness at the site of the insertion of the cord, and having a diameter of from sixteen to eighteen centimetres across its widest portion; its weight is about one pound.

Anomalies of Size. The thickness of the placenta generally is inversely proportionate to its extent. In rare instances a thin placenta extends almost entirely around the amniotic sac, owing to a persistence of all the chorionic villi; such a condition constitutes *placenta membranacea*. A large placenta usually accompanies a large fœtus, and *vice versa*.

Placenta Marginata. In this variety of placenta the membranes do not cover the entire fœtal surface, but leave a margin which may be the seat of numerous blood-clots, or, later, be marked by a circular whitish band; a healthy placental zone may develop just beyond this band. Sometimes the edge of the placenta appears as if slightly turned up; the term *placenta circumvallata* is applied to this condition. After studying many specimens, G. Klein concludes that placenta marginata is the result of a thickening of the margin of the decidua reflexa, caused by inflammation. Placenta marginata probably dates from the beginning of pregnancy and may interfere with the development of the fœtus, or even cause abortion. J. W. Williams classes this condition under the head of placental infarcts, the whitish band being fibrinous and representing the final modification of the effused blood.

Anomalies of Position. The normal situation of the placenta is in the upper segment of the uterus; attachment extending below the level of the retraction ring constitutes placenta prævia, the features of which are elsewhere described.

Anomalies of Shape. Instead of being oval, the outline of the placenta may be very irregular, in rare cases even crescentic or horseshoe shaped. When several cotyledons are excessively developed the placenta is said to be *multilobular*. Usually the cord joins the centre of the placenta; when it is inserted at the margin a *battledore placenta* results.

Multiple Placenta. There may be two placental masses of almost equal size or there may be accessory placentæ consisting of only a few cotyledons—*placentæ succenturiatæ*. The accessory placentæ are connected by a bridge of membranes upon which run the vessels from the umbilical cord. *Placentæ spuriæ* are groups of villi having no relation with the maternal blood-stream. Accessory placentæ have great clinical importance, as a physician unknowingly may leave placental tissue within the uterus and expose his patient to the dangers of hemorrhage and sepsis. If, after the delivery of the placenta, the membranes appear torn away near the placental margin, they should be washed and held up to the light in order to see if they contain the portions of ruptured vessels running to an accessory placenta; the least indication calls for manual exploration of the uterine cavity.

DISEASES OF THE PLACENTA.

Infarcts of the Placenta.[1] The following varieties of infarcts are mentioned by Williams:

1. Small whitish areas, of slight depth, upon the fœtal or maternal surface and sharply marked off from the surrounding placental tissue.
2. Wedge-shaped or rounded areas seen on section of the placenta and presenting a whitish fibrinous appearance.
3. One or more cotyledons, sometimes the greater portion of the organ converted into a pale, white, dense fibrous mass.
4. A rim of whitish or yellowish-white material extending for a varying distance around the margin of the fœtal surface of the placenta—*placenta marginata.*
5. Pinkish or brick-dust colored masses, solid and irregular in shape, of varying size, and most marked on the maternal surface. These are known as red infarcts. Less frequently there may be found dark-red or blackish areas scattered through the placenta. These blood-masses are separated from the placental tissue by a capsule of fibrinous material, and also are known as red infarcts, but more commonly are spoken of as *apoplexy of the placenta;* their pathology is not the same as that of the brick-dust colored areas.

FREQUENCY OF PLACENTAL INFARCTS. (Plate XXI.) Williams found that every one of the five hundred placentæ examined contained infarcts, although sometimes only of microscopic size: in 63 per cent. of the cases the infarcts measured one centimetre or more in diameter.

PATHOLOGY. In most cases the white infarcts represent the later stages of the red: the pink ones owe their color to the entanglement of red globules within the meshes of the fibrin. On section an infarct presents a variety of appearances. Some of the white ones show almost nothing but fibrin, except perhaps a few degenerated cells in the centre; in others, villi may be made out, but in a more or less degenerated state. A few of the white infarcts show no trace of fibrin, but are made up of degenerated villi pressed into a mass.

The exact processes which produce infarcts are still subjects for discussion. Williams comes to the same conclusions as Ackermann, Eden, and others that the changes first take place in the vessels of the villi, and are in the nature of an endarteritis and periarteritis, whereby the lumen of the vessels is narrowed or obliterated: this produces a coagulation-necrosis of the cellular layers covering the villus and leads to coagulation of the maternal blood lying in the intervillous spaces. Steffeck, on observing so-called decidual cells in the centre of many infarcts, considered that the

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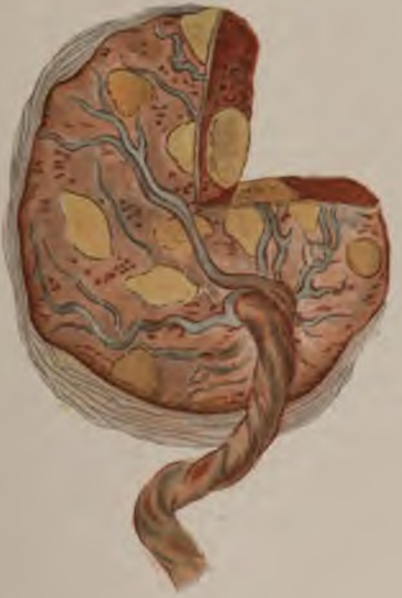
[1] Adapted from article by J. Whitridge Williams in American Journal of Obstetrics, June, 1900, entitled, "The Frequency and Significance of Infarcts of the Placenta, Based upon Microscopic Study of Five Hundred Consecutive Placentæ."

PLATE XXI.



PLACENTAL INFARCTION IN ECLAMPSIA

process had its beginning in excessive proliferation of the decidual cells which grow up about the villus and check nutrition: in the depths of the placenta these cells are supposed to come from the septa penetrating the organ from the maternal decidua. Steffeck considers that the arterial changes are secondary and not always present. Veit suggests endometritis as the primary cause. Williams, while not denying Steffeck's conclusions to be applicable to some cases, thinks that the so-called decidual cells are not maternal but fœtal in origin. The only explanation offered for those infarcts which contain no fibrin is that thrombosis has plugged certain vessels in the maternal decidua, so that the blood is shut off from a limited area in the placenta; the pressure in the surrounding portions compresses the villi lying in the affected region into a mass which soon begins to show evidences of degeneration. Nothing very conclusive can be said concerning the dark-red and blackish infarcts, except that they are the result of processes other than those mentioned. Owing to the fact that in many cases these infarcts appear to be surrounded by a capsule of fibrin, it has been suggested that they are the result of a fresh effusion of blood into a previously formed infarct; there seem to be pathologic findings which warrant such a conclusion. In the centre of some infarcts, especially the large pink ones, there may be found cavities containing thick, grumous material resembling pus; the presence of these cavities led the older observers to the opinion that placentitis was the underlying factor in the production of infarcts. Microscopic examination, however, shows that the material is not pus, but cellular débris and softened thrombus. In other infarcts the cellular contents may degenerate and a cavity filled with fluid be the result; by this process cysts of the placenta are formed.

ETIOLOGY. But little is known of the causes underlying infarct-formation in the placenta. There is no evidence of a bacterial origin, and they are found so often in non-syphilitic women that specific disease cannot be an important element. Albuminuria is given as a cause, particularly of placental apoplexy, and there seems to be a decided relation between the two affections. Cagny found red infarcts in one-third of the albuminuric cases; Martin noted infarcts in 47 per cent. of women having albumin in their urine, and in 67 per cent. of these the children were born dead or imperfectly developed. Exactly how albuminuria produces the infarcts is not known. Infarct-formation is not particularly marked in cases of acute eclampsia, owing perhaps to the brief duration of the disease. Moderate degrees of infarct-formation are to be regarded as signs of senility of the placenta, and are analogous to the changes taking place in the villi of the chorion at an earlier period.

EFFECT UPON FŒTUS.—The moderate degrees of infarct-formation have no effect upon the fœtus, but extensive interference with the function of the placenta would result in fœtal death. As has been pointed out under Toxæmia, albuminuria is a frequent accompaniment of auto-intoxication, and in those cases in which the fœtus dies and infarcts are found in the placenta it is probably the toxic state of the blood rather than the local condition which produces the bad result.

DIAGNOSIS AND TREATMENT.—Slight infarct-formation displays no symptoms. If the condition leads to fœtal death, symptoms of abortion develop. The treatment consists in relieving toxic conditions and in emptying the uterus after the death of the fœtus is assured.

Calcareous Degeneration of the Placenta. On passing the finger over the maternal surface of the placenta small sand-like bodies often may be felt, which consist of calcic or magnesic carbonates or phosphates. Sometimes these grains are aggregated into needles or small plates. J. W. Williams states that in examining infarcts it was common to find in them deposits of calcareous material, so probably this degeneration usually is secondary to deposits of fibrin; it is without pathologic importance.

Fatty Degeneration. Fatty degeneration may be observed in small areas, particularly in those situated near the margin of the placenta. The causes are not known, but the degeneration probably is secondary to other processes, such as infarct-formation.

Tumors of the Placenta. These are quite uncommon; Albert collected all reported cases, which, together with four of his own, amounted to forty. The tumors consisted of myxomata, adenomata, and sarcomata. Diagnosis before labor usually is impossible; a rapidly growing tumor might lead to expulsion of the fœtus and retention of the placenta.

Cysts. Cysts are frequently found on the fœtal surface of the placenta in the neighborhood of the insertion of the cord; they rarely are as large as pigeons' eggs. The contents may be clear and gelatinous or brown and watery. Most observers consider that placental cysts are the result of degeneration taking place in infarcts, but Peiser recently has demonstrated that cysts may develop as a result of liquefaction of the cells covering the villi; these cellular elements are quite frequently present in the centre of an infarct.

Placentitis. By this term is meant inflammation of the placenta, although the organ never shows such signs as redness, swelling, and formation of new vessels. The main changes consist of modification of the connective tissue surrounding the vessels, producing a condition analogous to that found in the liver or kidneys of an adult. The placenta may become indurated and adhere firmly to the uterine wall. Delore speaks of a bacterial placentitis, which he ascribes to the passage of bacteria through the placenta to the fœtus, as we know that micro-organisms can reach the fœtus by that route; he even divides the affection into decidualitis and villositis according to the parts involved. The changes seem to be much the same as those described under Infarcts, and the propriety of employing a term implying inflammatory processes may well be questioned.

Syphilis of the Placenta. The classic description given by Fraenkel in 1873 still expresses most of our knowledge on this subject; he makes the following statements:

1. When the disease has been transmitted from the father the principal lesion is hypertrophy of the villi.

2. When the mother is infected with syphilis the placenta is degenerated and the fœtus diseased; the villi are filled with fatty granules, the vessels are obliterated and their epithelial covering is thickened or absent.

3. If the mother is infected during the generative act at the same time as the ovum, syphilitic foci will often develop in the maternal placenta.

4. If the mother is syphilitic before conception, or becomes so shortly after, the placenta is syphilitic in about 50 per cent. of the cases.

5. If the mother is not infected until after the seventh month of gestation, both fœtus and placenta wholly escape.

6. Infection of the fœtus during delivery has not been proved.

Bönet states that under the microscope various lesions are observed, such as hemorrhagic foci, thrombosis, white infarcts, and fatty degeneration. The vessels show thickening of their walls and diminution of their calibre.

Pinard, Lapage, and Schwab call attention to a marked increase in the weight of the placenta in proportion to the weight of the fœtus. Pinard considers this hypertrophy to have a certain diagnostic value.

ANOMALIES OF THE UMBILICAL CORD.

The anomalies of the cord embrace variations in length and placental insertion, coils, knots, exaggerated torsion, stenosis of vessels, and navel-cord hernia.

Length. The length of the cord averages from forty to sixty centimetres, but there are instances in which the length was diminished to ten centimetres and increased to three metres.

Shortness of the cord may be absolute or relative: relative shortness is produced by coils about the fœtus, and dystocia may be the result, the presenting part being hindered in its descent or making rapid retrograde movements after each uterine contraction. During labor, if a short cord does not rupture, it may cause uterine inversion or detachment of the placenta.

When the cord is unusually long there is a predisposition to funis presentation and prolapse: a loop may become caught around the fœtus; for instance, between the buttocks in a breech presentation, and relative shortness result.

Insertion. In some cases the cord terminates in the membranes, between which the vessels continue their course to the placenta—*insertio velamentosa*. In such a relation there is danger that the vessels may be ruptured during labor, and unless rapid delivery follows the child's life be lost.

Coils. It is common for the cord to be coiled once or twice about the child's neck: nine turns have been noted by Braun. When the coiling is sufficient to produce relative shortness of the cord there is danger that, during descent, a fatal strangulation of the tissues may result. Coiling is most dangerous when the cord is about the neck in a breech labor, as the constriction cannot be released until late in the delivery. It has been suggested that a coil might be drawn tight enough around a limb to produce amputation, but it is probable that the cases of so-called spontaneous amputation are the result of constriction by amniotic bands, for before the cord could be made sufficiently tense to cut through the fœtal tissues the circulation in the umbilical vessels would be shut off and death of the fœtus take place. Coils are said to occur more frequently when the children are males and in multiparæ.

Knots. A knot may result if the fœtus be passed through a twisted loop of the cord; several knots may be produced in this way, the favoring conditions being a long cord and excess of liquor amnii. If the knot is old, there may be atrophy of the jelly of Wharton at that point; in recent cases the tissues of the cord are usually unchanged. It is not common for the knot to be pulled tight enough to cut off the circulation in the vessels, and the gelatinous material acts as an efficient protection, at least for a time. In twin pregnancies, when the children are in the same amniotic sac the two cords may become united in so firm a knot that the death of both children may result.

Torsion. The cord normally displays an apparent twisting from left to right, and occasionally there is an actual torsion, which may be so extreme that the vessels are almost obliterated. Three hundred and eighty twists have been observed. The seat of the torsion is usually at the umbilicus, and very seldom at the centre of the cord or near the placenta. The fœtus is found dead in all cases of pronounced torsion, and the excessive twisting is recognized as a post-mortem change, and not as the cause of the fatality.

Stenosis of Vessels. In certain cords the calibre of the vein is diminished, so that great dilatation may take place in that portion between the seat of constriction and the placenta; hydramnios and œdema of the placenta may be the result. In cases of syphilitic infection of the fœtus the vessels of the cord may be surrounded with a deposit of connective tissue.

Navel-cord Hernia. By this is meant protrusion of some of the contents of the abdominal cavity at the point of insertion of the umbilical cord. It is the result of arrested embryonic development, and usually is associated with other deformities, such as atresia of the rectum. The contents of the sac are usually omentum and intestine, but any of the abdominal viscera may be added.

TREATMENT. During the separation of the cord a dry dressing must be applied with sufficient pressure to prevent protrusion of the hernia. While the opening is closing by granulation strict asepsis must be observed. The best treatment is the operative, and should be carried out immediately after birth. Under light chloroform anæsthesia the cord and its coverings are removed by an elliptical incision; adhesions are separated and the layers of the abdominal wall are brought together by catgut suture *en étage*; one or two through-and-through sutures of silkworm-gut may be introduced first.

CHAPTER XIV.

PATHOLOGY OF THE FŒTUS.

ANOMALIES.

UNDER malformations are included all imperfect, deviating formations of the entire body or its parts which can be attributed to malposition in the uterus or deviation from normal intra-uterine development. Those minor deviations of development which occasion no marked change of form and no disturbance of function are simple anomalies. Those malformations which produce remarkable deformity of the body are monsters. Of these there are three great groups: 1. Monstra per defectum. 2. Monstra per excessum. 3. Monstra per fabricam alienam. These are again divided according to origin and according to outward resemblance into a large number of subdivisions.

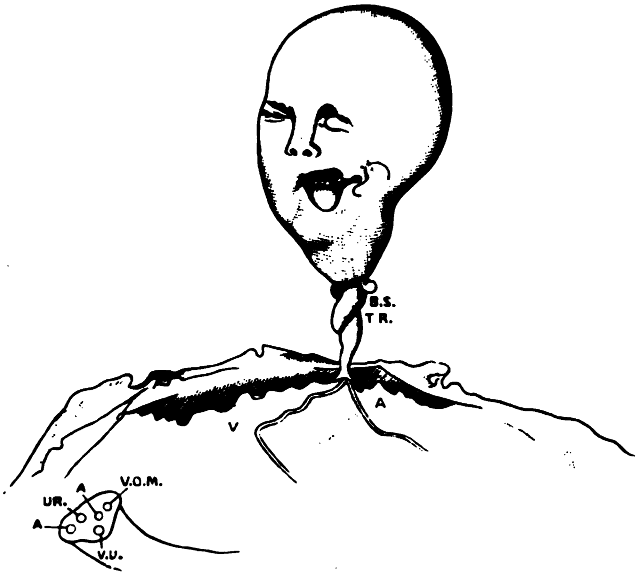
Monstra Per Defectum

Are malformations characterized by lack of, or incomplete, development.

I. The defect is the principal characteristic: simple anomalous formation.
- A. Absence or stunting of large sections of the body.
    1. Amorphus, Acardiacus amorphus; a formless mass covered with skin.
    2. Mylacephalus: Vertebræ, ribs, and pelvis present; no heart; extremities indicated; also head, by a lump.
    3. Acephalus (Plates XXII. and XXIII.): Abdominal portion of body, with one or two extremities, and various-sized portions of vertebræ; occasionally with upper extremities, and a rudimentary head. When present, the thorax is open anteriorly; the heart is always absent. Other internal organs are present or absent.
    4. Acormus, bodyless (Figs. 220, 221, 222). Head with imperfect brain. Cord inserted in vicinity of throat.
- B. Absence or stunting of separate parts.
    - *a*. Head.
        1. Acrania (Plates XXIV., XXV., and XXVI.): Defective vertex, usually associated with anencephalus; defective brain, and partial defect of the skin. The base of the skull is greatly shortened. Originates through superficial synechia of fœtal head and amnion, or as a result of fœtal hydrencephalocele. Acrania is also occasionally associated with pseudoencephalocele.
        2. Hemicrania: Frontal, occipital, and parietal bones rudimentary. Brain rudimentary or absent; in the latter case usually associated with pseudoencephalocele.
        3. Microcephalus: Brain small in consequence of premature ossification of skull bones.

4. Cretinismus: Too short skull base, from premature ossification of the synchondrosis sphenobasilaris.

FIG. 220.



Acardiacus acormus. (BARKOW.)

bs. Rudiment of the left upper extremity. *tr.* Rudiment of intestine. *a, a, a.* Arteries. *v.* Vein. *v. u.* Umbilical vein. *v.o.m.* Omphalo-mesenteric vein. *ur.* Urachus.

FIG. 221.

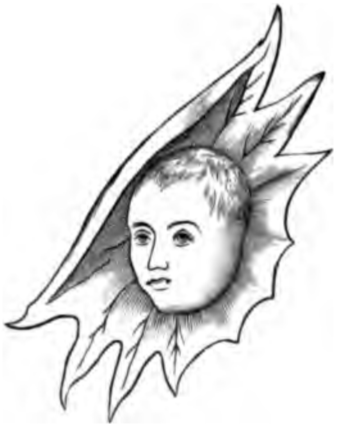
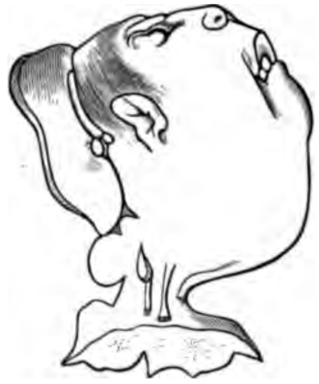


FIG. 222.

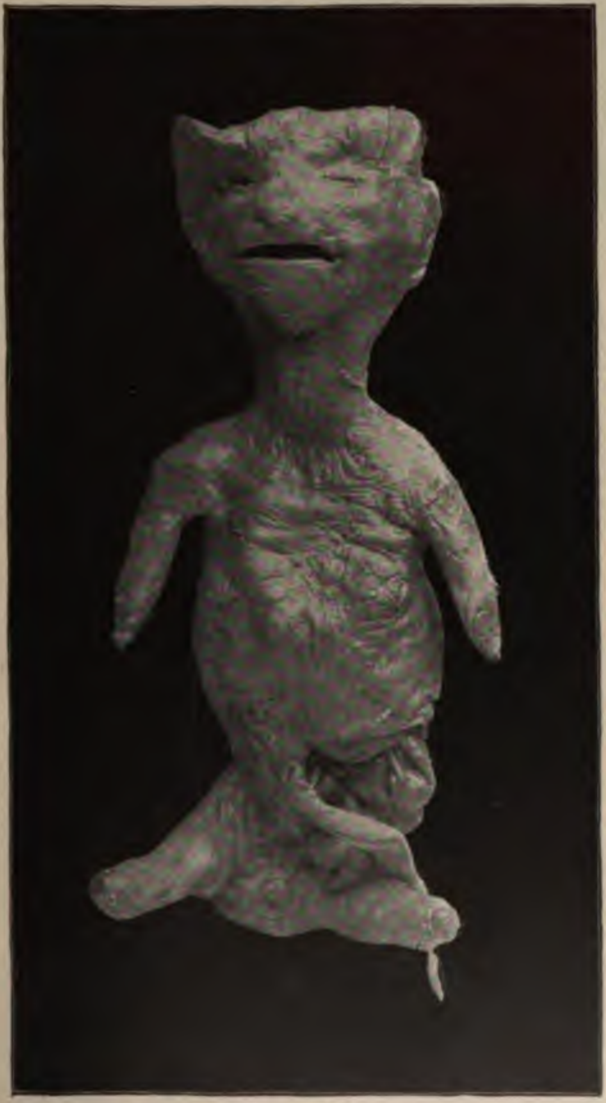


Acardiaci acormi. (AHLFELD'S Atlas.)

5. Cyclopia (Plates XXVII. and XXVIII.): Both orbital fossæ are apposed or confluent, or there is one eye which lies in one fossa in the median line. In the higher grades the ethmoid, nasal septum, and vomer are absent. The optic chiasm and

tract persist or are absent. In the brain single parts, as convolutions, thalamus, or olfactory nerve, are wanting, or it terminates anteriorly as a simple bladder.

FIG. 223.



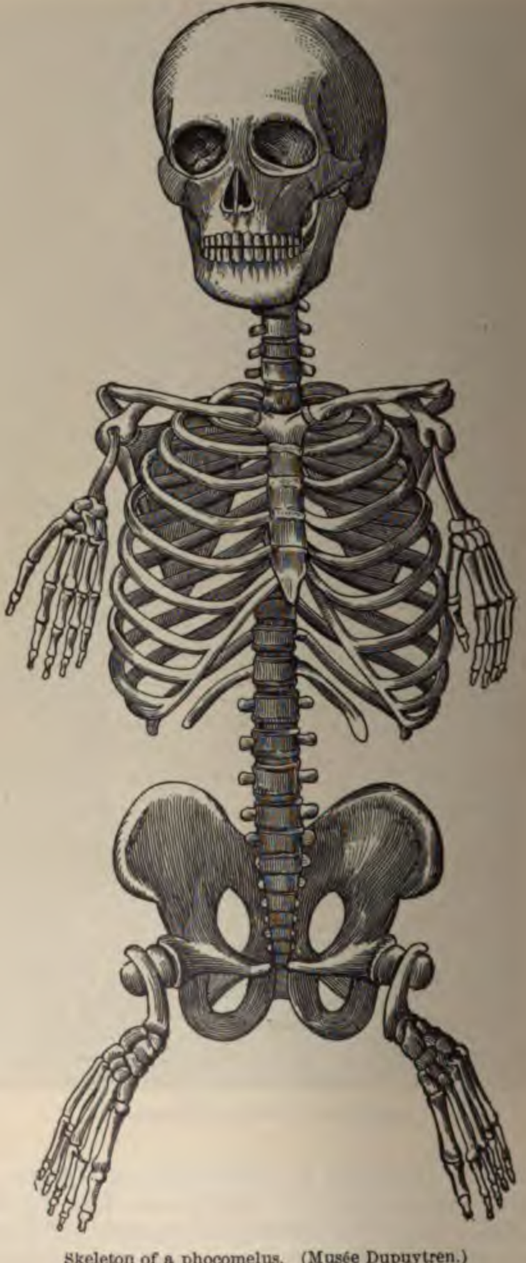
Hemimelus. (HIRST and PIERSOL.)

6. **Agnathia**: Anomaly of under jaw, or absence of the lower jaw processes of primary blastoderm. Usually the upper jaw, palate, and sphenoid bones are stunted; the ears approach each other, touching at their under surfaces.

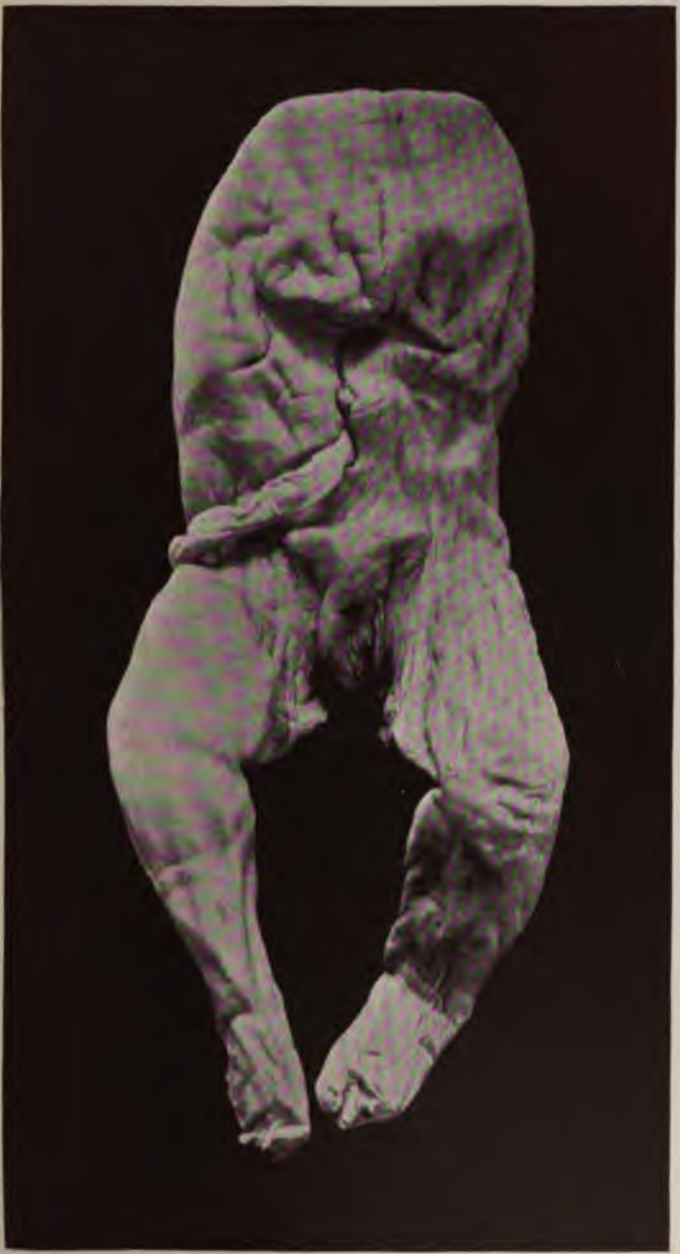
7. Aprosopus : Malformation of larger or smaller portions of the face—*e. g.*, nose, mouth, eyelids.

β. Vertebral column, cord, chest.

FIG. 224.

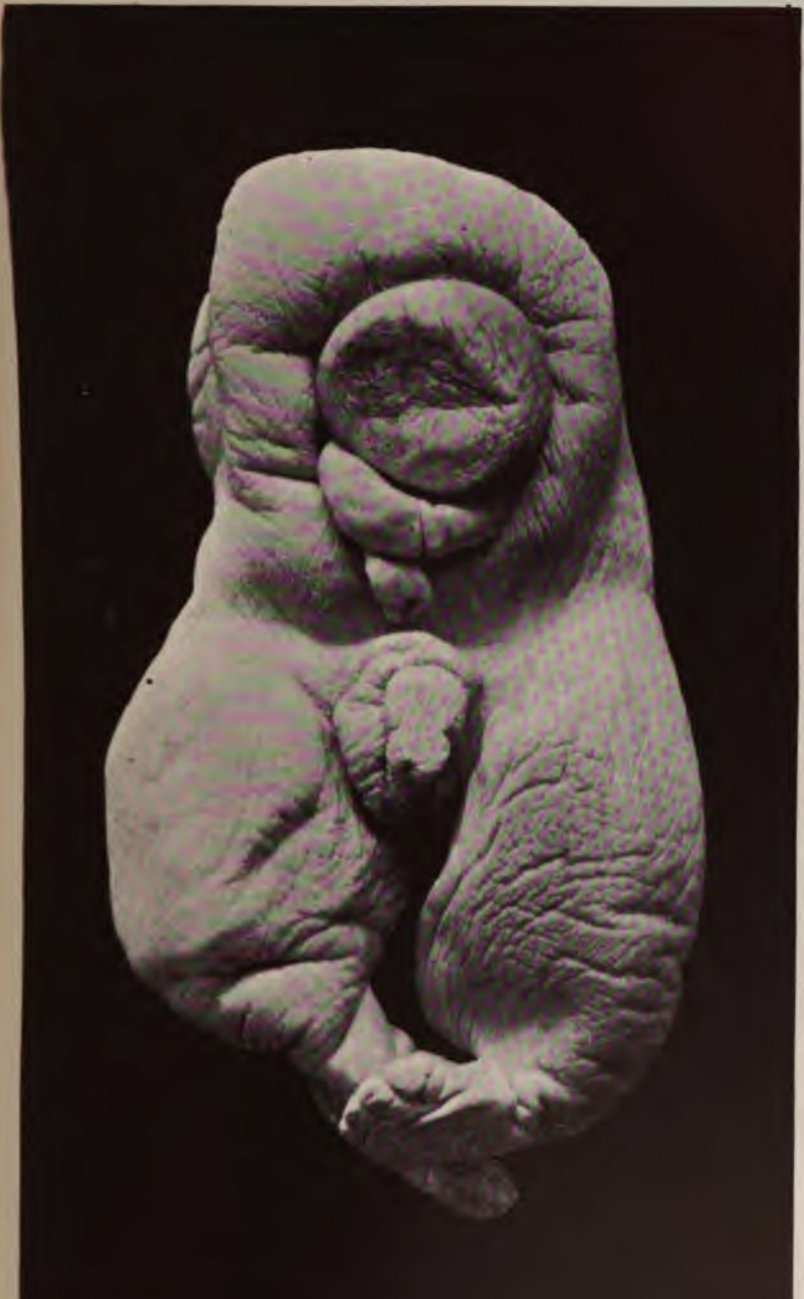


Skeleton of a phocomelus. (Musée Dupuytren.)



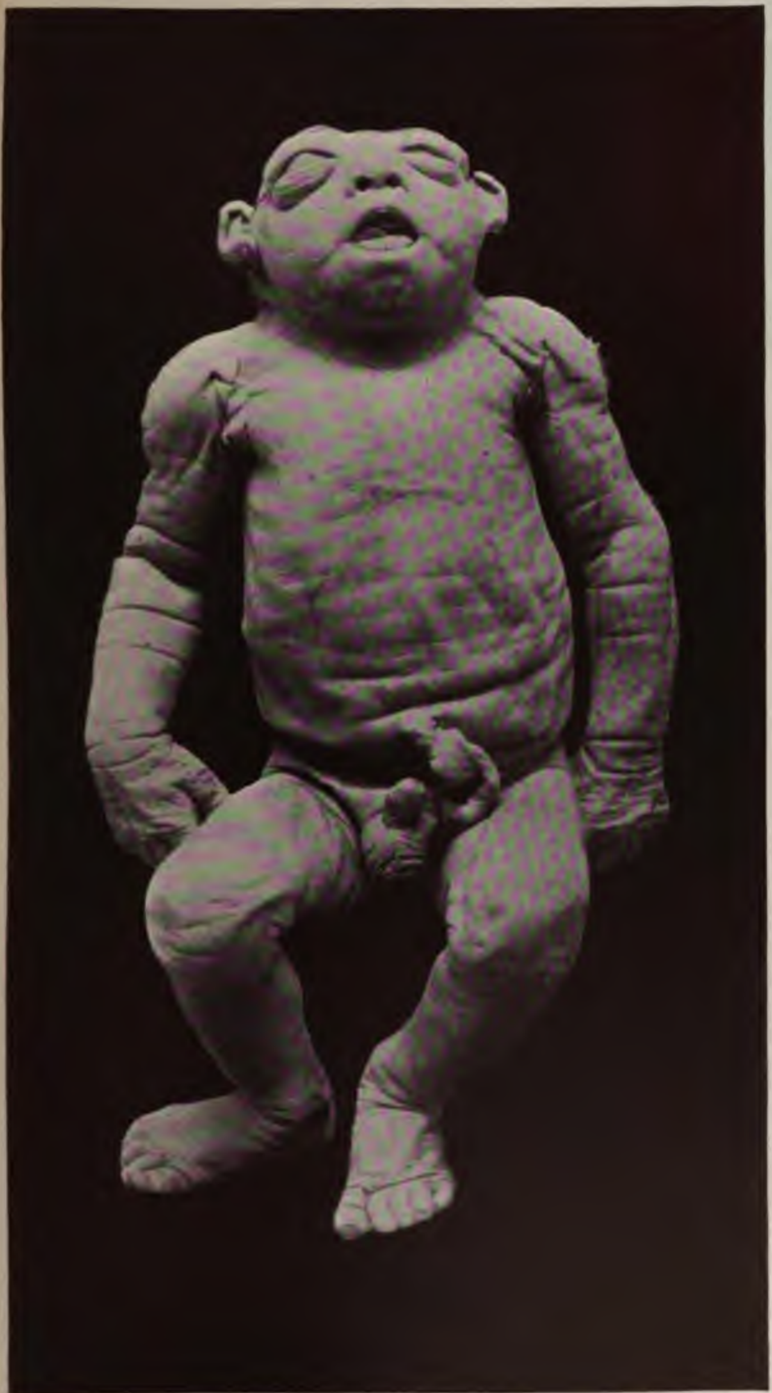
Acephalus. (Hirst and Piersol.)

PLATE XXIII.



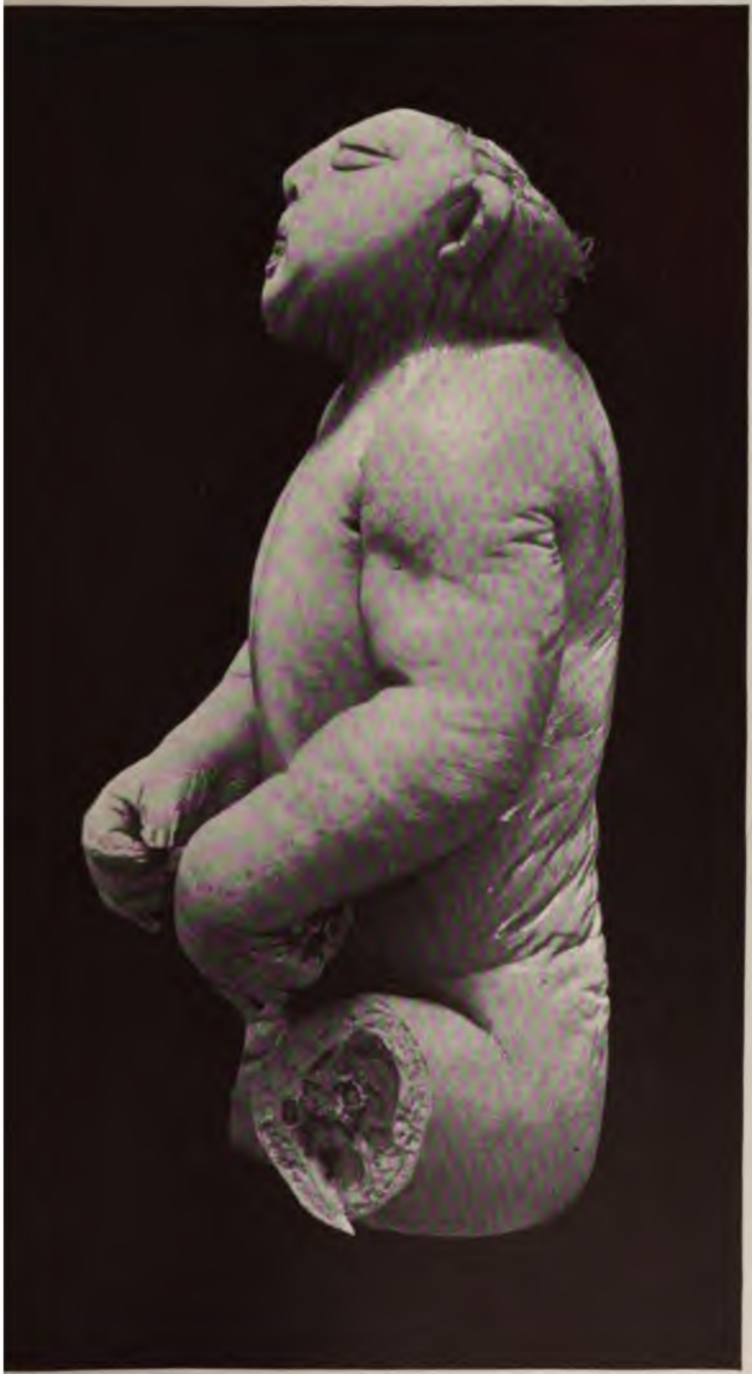
Acephalus. (Hirst and Piersol.)

PLATE XXIV.



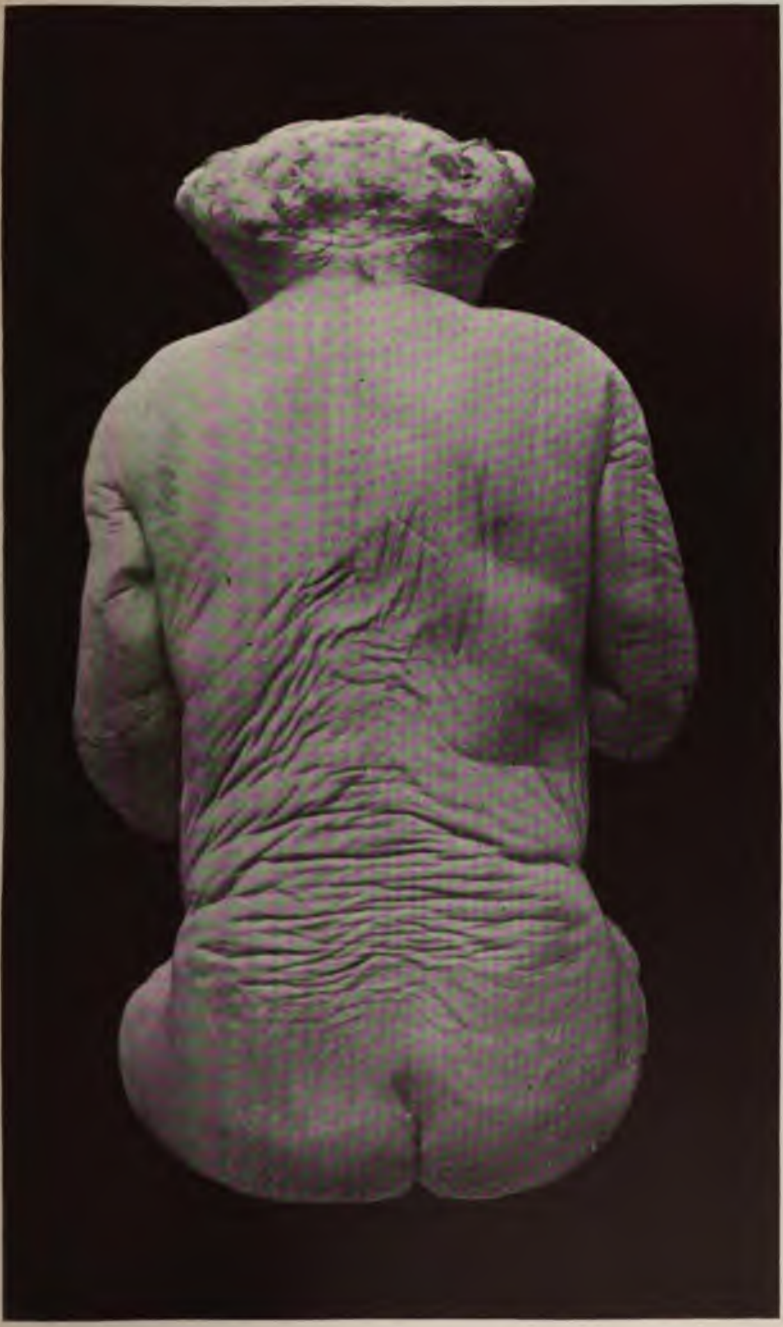
Pseudencephalus. (Hirst and Piersol.)

PLATE XXV.

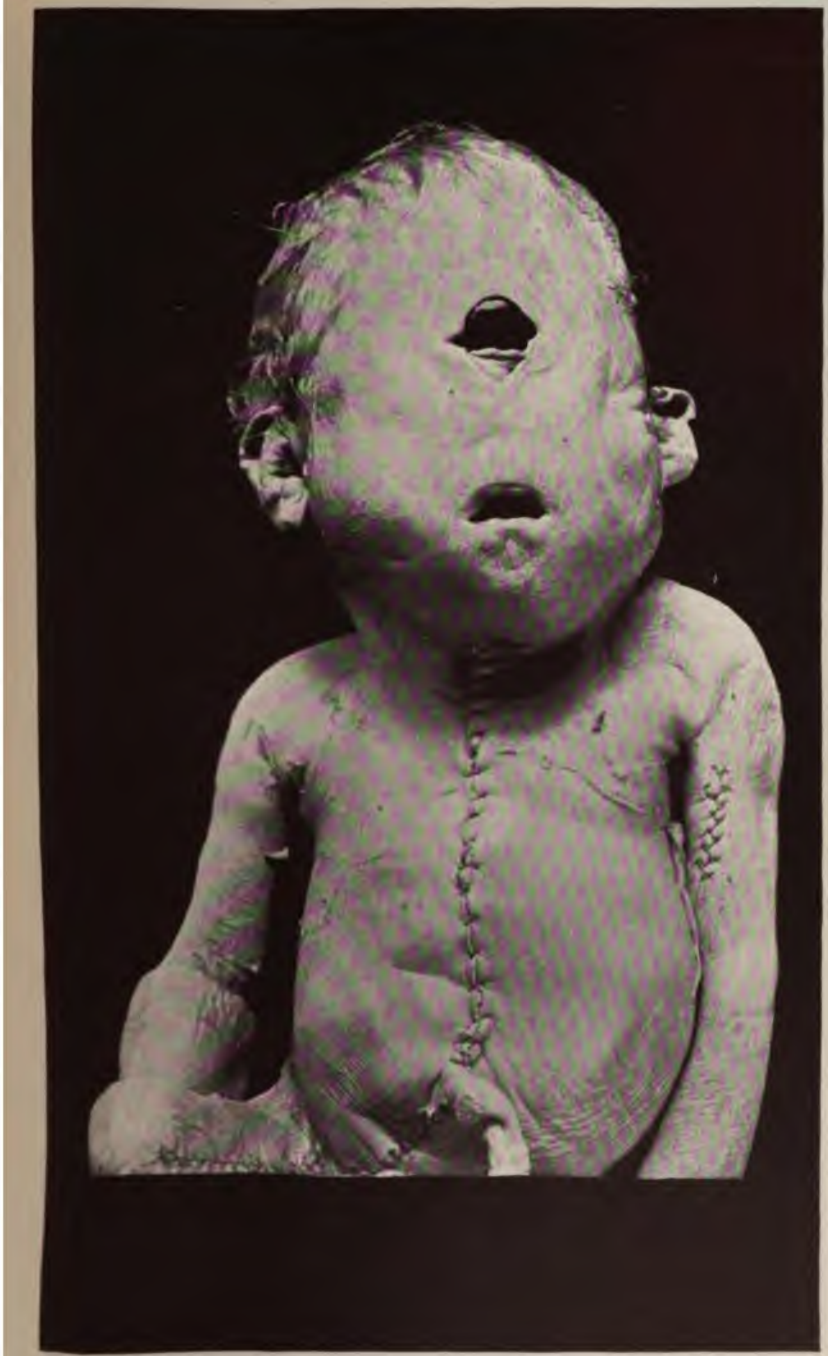


Anencephalus. (Hirst and Piersol.)

PLATE XXVI.



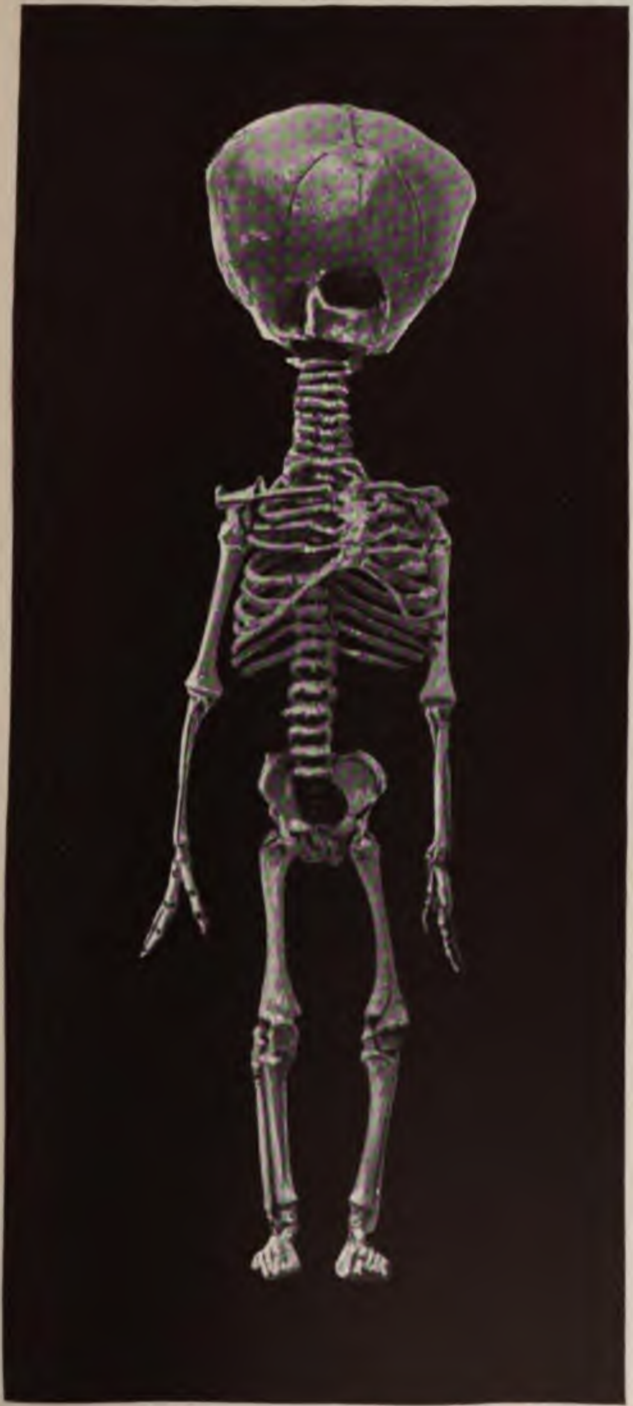
Anencephalus. (Hirst and Piersol.)



Cyclocephalus. (Hirst and Piersol.)

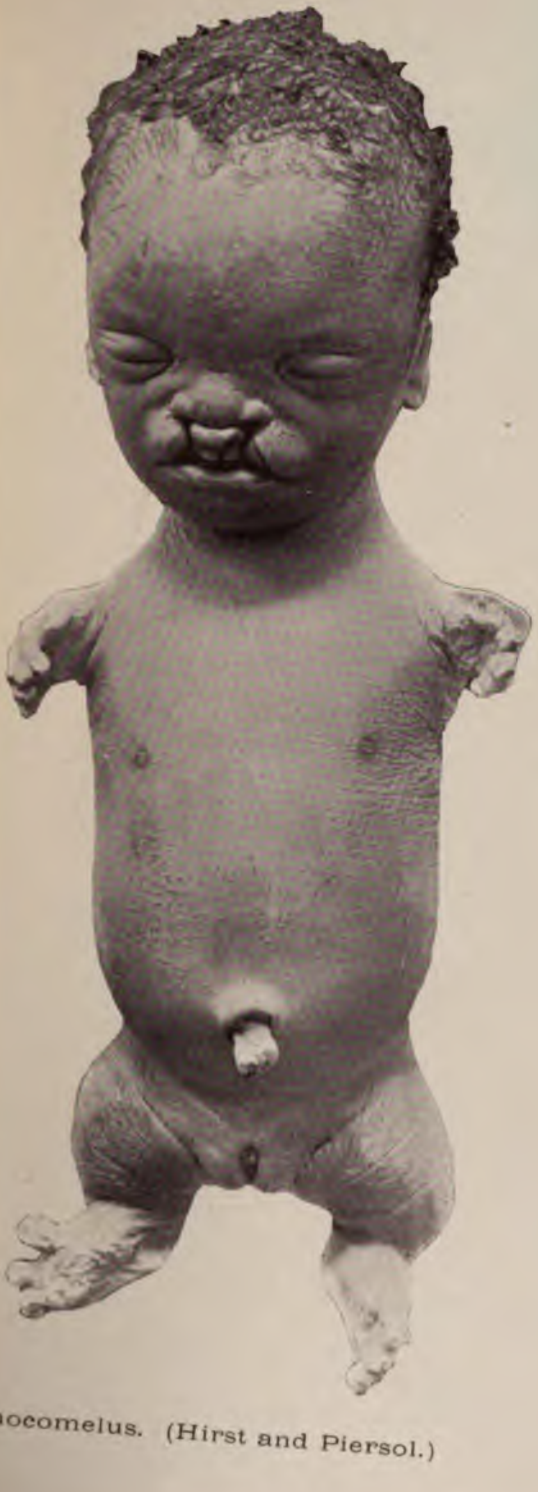
(Cyclops.)

PLATE XXVIII.



Skeleton of Cyclocephalus. (Hirst and Piersol.)

PLATE XXIX.



Phocomelus. (Hirst and Piersol.)

. Amyelie: General or partial defect of the spinal cord; originates from hydromyelocele.

Absence of several ribs and vertebræ.

elvis and extremities.

Amelus: Absence of all the extremities.

Peromelus: Malformation of all extremities.

Phocomelus (Plate XXIX. and Fig. 224): Hands and feet rest on the shoulders and hips.

Micromelus: Abnormally small limbs.

Abrachius: Absence of arms.

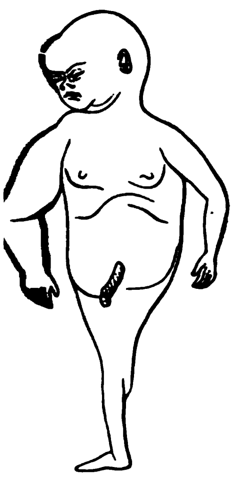
Perobrachius: Defective hands and forearms on normal arms.

Microbrachius: one or both arms too small.

Monobrachius: Absence of one upper extremity.

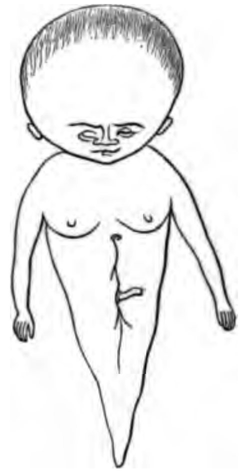
Sympus (Figs. 225 and 226), Syren formation: Fusion of lower extremities; pelvis and sacrum wanting; atresia of urethra and rectum.

FIG. 225.



(Sympus monopus. FORSTER.)

FIG. 226.



Strenomelus. (Sympus apus. FORSTER.)

0. Apus (Fig. 227): Lower extremities absent.

1. Monopus (Fig. 228): One lower extremity absent. The corresponding half of pelvis also absent (prolapse of intestine).

2. Peropus: Stunted formation of one or both lower extremities.

3. Micropus: Lower extremities small.

Internal organs, intestines: The absence of entire organs is common with malformations of head, and without a heart. It may occur without these anomalies.

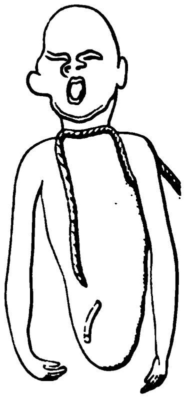
Absence of nose in cyclopia.

Absence of lungs, with absence of diaphragm, and fœtal hydrothorax.

Absence of lips: Acheilia.

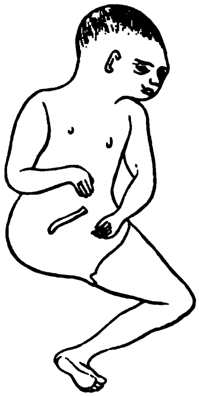
Absence of tongue: Aglossia, usually with agnathia.

FIG. 227.



Apus.

FIG. 228.



Monopus.

Absence of gall-bladder; the ductus hepaticus is abnormally wide.
Absence of one kidney; synchronous compensatory hypertrophy of the other.
Absence of urethra, with cloaca formation.
Absence of urinary bladder; ureters open directly into urethra.
Absence of one or both ovaries.
Absence of uterus.
Absence of one or both tubes.
Absence of external female genitals.
Absence of vulva alone.
Absence of hymen alone.
Absence of one or both mammary glands, commonly with synchronous absence of ribs.
Absence of nipples.
Absence of prepuce.
Absence of penis.
Absence of one or both testicles.
Absence of seminal vesicles.
Absence of pericardium, with ectopia cordis.
Partial defect is found in the brain; *e. g.*, absence of corpus striatum.
Absence of septum narium.
Absence of inferior turbinated.
Absence of epiglottis.
Absence of superior segment of œsophagus, and blind ending of pharynx.
Absence, partial, of trachea, with communication with œsophagus.
Absence of tracheal cartilages, generally with abnormal fusion.
Absence, partial, of one lung, with compensatory hypertrophy of the other.
Absence of frænum linguæ, with fusion of tongue with floor of mouth. The frænum may be simply too short.

Absence of middle segment of œsophagus with sac-like dilatation of the superior end; commonly communication with trachea.

Absence of colon and rectum.

Absence, partial, of urethra, in epispadias, hypospadias.

Absence, partial, of hymen; hymen is cribriform, fimbriated, or abnormally wide.

Absence, partial, of spermatic cord.

Absence, partial, of prepuce, short frænum, phimosis.

Absence, partial, of heart.

1. Simple muscular sac, with veins.
2. A chamber with arteries, and auricle and primitive veins.
3. Two auricles, one ventricle; aorta, primitive, gives off pulmonary veins.
4. Two ventricles and auricles. Atresia of ostium aorticum, patency of septum ventriculorum and foramen ovale. Pulmonary artery empties into aorta. Aorta descendens absent.
5. Aorta ascendens and descendens not associated; the latter communicates with pulmonary artery through ductus Botalli.
6. Arteria pulmonalis narrow, closed, or absent; its branches communicate with aorta.
7. Both arteries abnormally narrow; heart-cavities greatly dilated, septum incomplete.
8. Situs transversus of the aorta and pulmonary artery.
9. Patency of foramen ovale, ventricular septum, and ductus Botalli.
10. Anomalous formation of valves; increase or diminution in their number.

C. Abnormal smallness.

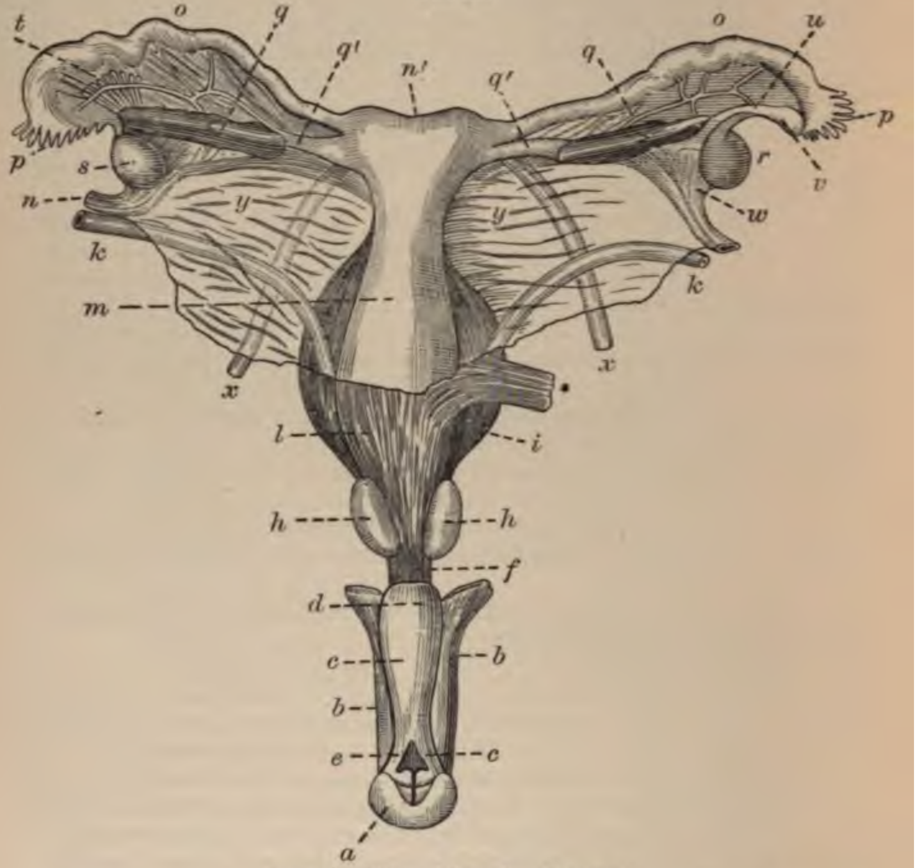
1. Dwarfs (Nansomia, Microsomia): Fully developed individuals under 112 cm. Generally the head and trunk are of relatively unequal size. Occasionally all parts are in proportion.
2. Single parts abnormally small: Heart and bloodvessels (hypoplasia in chlorotics); lungs (in diaphragmatic hernia and dystocia of abdominal organs into thorax); brain (microcephalus), spleen, thyroid, lips, tongue, frænum, stomach, penis, testicles, toes, ears.

II. Arrested development characterized by disturbance of the normal metamorphosis of an originally properly segmenting ovum: No defect, but metamorphosis of part or organ in normal position, with derangement of its component parts.

1. Formation of two or three renal pelves, through unusual arrangement of the separate renculi of the kidney; also lateral disposition of the pelves.
2. Fusion of all the renculi, to form one kidney: Horseshoe kidney. The fusion is usually on the inferior pole, and occasionally associated with dystocia in the pelvic cavity.
3. Communication between trachea and œsophagus.
4. Communication between rectum and vagina (cloaca formation).

5. Hermaphroditismus. (Fig. 229.) There are two varieties—true and false. In the former, male and female generative organs are present; in the latter, there are a male or female generative canal and either male or female genitalia. Of the true variety there are three forms:

FIG. 229.



Hermaphroditismus bilateralis. (HEPPNER.)

a. Glans penis. *b.* Corp. cavernosa penis. *c.* Corp. cavernosa of urogenital canal. *d.* Its bulb. *e.* Its anterior arm. *f.* Membranous part of urogenital canal. *h.* Prostate. *i.* Bladder. *k.* Ureters. *l.* Vagina. *m.* Uterus. *n′.* Fundus uteri. *o, o.* Tubes. *p, p.* Their infundibula. *q, q.* Ovaries. *q′, q′.* Ligaments of ovary. *r.* Right testicle. *s.* Left testicle. *t.* Left parovarium. *u.* Right parovarium. *v.* Hydatid of Morgagni. *n, w.* Bloodvessels. *x, x.* Round ligaments. *y, y.* Broad ligaments. *. Muscle fibres from bladder and vagina.

1. Bilateral: Ovaries and testicles on both sides.
2. On one side, an ovary; on the other, a testicle.
3. Unilateral: On one side, testicles; on the other, ovaries.

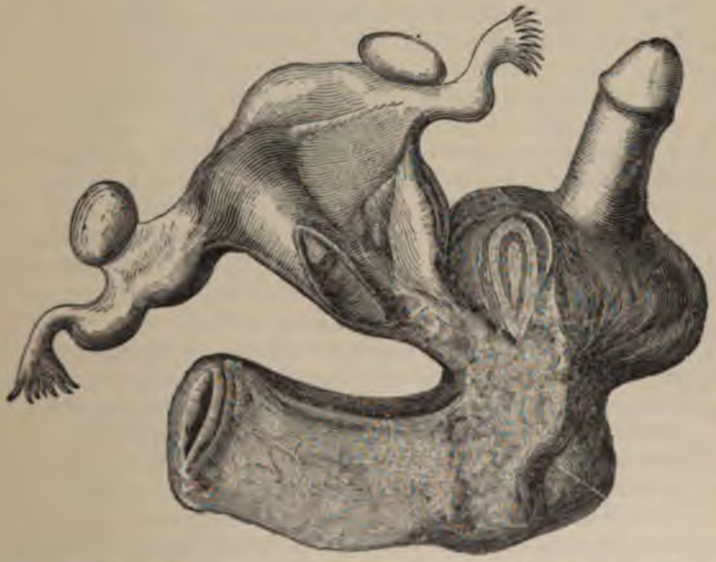
Of the pseudohermaphroditism (Fig. 230), two forms—*i. e.*, male and female:

1. Male pseudohermaphroditism (with testes) falls into three subdivisions:

- (*a*) Complete: Testicles present; tubes, uterus, vagina, and female external parts.
- (*b*) Externus: Testes and male genital canal, with female external parts.
- (*c*) Internus: Persistence of Müller's ducts, rudimentary vagina, uterus, and tubes; testes and male external parts.

2. Feminine pseudohermaphroditismus (with ovaries) falls also into three subdivisions:
   - (*a*) Complete: Ovaries, persistent Wolffian ducts; male external genitals.
   - (*b*) Externus: Ovaries, internal female genital canal, external male organs.
   - (*c*) Internus: Ovaries; external female genitals; persistent Wolffian ducts.

FIG. 230.



Spurious hermaphroditism. The round bodies are testicles. (After HIRST and PIERSOL.)

In hitherto observed cases of the true variety, functionally active male and female organs were not present; the testicles or ovaries were stunted. The majority of the false variety belong to the male sex. The indefinite location of the organs of generation, and the indefiniteness of all external appearances—voice, beard, breasts, sexual instincts.

III. Arrest of development with prevention of complete ripening of the embryo: Persistence of a certain stage in development.

- A. Duplex uterus and vagina through incomplete fusion of Müller's ducts, or through stunting of the same. Rarely the uterus and adnexa fail completely; usually a solid rudiment obtains. Uterus unicornis arises from absence or stunting of one Müller's duct.
- B. Cleavage: Most of the cavities and canals of the body are originally plates, which bend to form rings in the first month; and by

apposition and fusion of their edges, complete the cavities and canals. Hinderance of this apposition and fusion results in cleavage of the part. Lips, jaws, palate, neck, trachea, intestines, bladder, skull, vertebræ, thorax, and abdomen may thus remain separated. Cloaca formation consists in arrested development, resulting in communication between rectum, bladder, and the genital canal; this arrest of development occurs from the fourth week of embryonic life to the middle of the third month.

1. Cranial and vertebral cleavage: Cranioschisis, rachischisis, craniorachisis are in small part due to embryo-amniotic adhesions, mostly to lesions of the central nervous system, which are traced to the meninges. Œdema of the cerebro-spinal arachnoid (hydromeningocele cerebralis and spinalis) or ectasia of the ventricles and central canal of the cord (hydrencephalocele, hydrocele medullæ spinalis) either prevents fusion of the posterior vertebral arch or leads to resorption and perforation of the bones. Spina bifida is in rare cases a pure hydromeningocele spinalis, as a rule only in the inferior portion of the cord: hydromeningocele spinalis sacralis or lumbosacralis. When the cleavage is situated higher up there is usually a hydromyelocele. This is as a rule associated with marked stunting, with usually complete interruption of the cord. The spinal processes usually fail completely in spina bifida. Occasionally anterior vertebral fissure occurs with spina bifida. As a rule the protruding sac has in its centre a funnel-shaped deepening. This is the place of fusion with the inferior end of the spinal cord. Hydrencephaloceles, with and without cerebral atrophy, are located usually in the median line, most commonly complicated with spina bifida atlantis or cervicalis. Through pressure the adjacent areas of brain and cord are destroyed. When the sac is very vascular it forms at the base of the skull a red, spongy mass: fungus cerebri, pseudoencephalocele.
2. Cleavage of lips, jaw, and palate (Plate XXIX.). Wolf's jaws: chelio-gnato-palato-schisis, single or double sided, through imperfect conjunction of upper jaw and palatal processes; the first with the anterior end of the frontal process to the middle jaw and vomer. The fissure stretches through the lip, upper jaw, and palate. The soft palate and uvula are cleft in the middle. There is open communication between nose and mouth. This anomaly is present in cleavage of chest and abdomen. The upper lip and jaw can be simply cleft—unilateral or bilateral. The cleavage can extend to the nares. In hare-lip either a fissure or cleavage obtains, which in the latter case can reach the nares. Hare-lip is oftener left-sided; but may be bilateral.
3. Fistula coli congenita is a lateral or median opening, about 2.5 cm. above the sterno-clavicular joint, on the inner border of the sterno-mastoid. The opening is very small, and covered with ciliated epithelium, and has a blind end, which is occasionally sacculated. Lateral fistula is resultant from hindered closure of the third and fourth embryonic plates; the median

fistula, from absence of conjunction of the third and fourth embryonic plates.

4. Cleavage of chest and abdomen lies always in the anterior median line of the body. Through hinderance of juncture of the visceral plates the entire thorax and abdomen to the navel are cleft. The thoracic and abdominal viscera are then displaced forward. In simple thoracic cleavage ectopia cordis is usual. Sternal fissure is the least degree of thoracic cleavage. Gastroschisis, or abdominal cleavage, may stretch from manubrium to symphysis, ensiform to the pubis or navel. In the latter case, separation of cord, omphalocele, or umbilical hernia of the cord is present. If the abdominal cleavage reaches the pubis, vesical cleavage is also present.
5. Vesical cleavage: Ectopia vesicæ urinariæ is characterized by the appearance of the posterior bladder wall through a cleft abdominal wall. The urethra is also occasionally cleft and forms an open border leading to the upper surface of the penis —epispadias. Usually cleft bladder is associated with imperfect fusion of the symphysis, absence of clitoris and vagina, vaginal atresia, and stunting of penis.

- Intestinal cleavage: Fissura intestinalis congenita is a rare complication of abdominal cleavage. Here, as in vesical cleavage, an open cæcum or colon ascendens appears in the abdominal cleft.
- Cloaca formation:
  1. With abdominal and vesical cleavage: Abdominal viscera protruded and surrounded by a sac, on the under surface of which is seen the cloacal orifice. The intestinal opening is located above in the centre of the cloaca; the colon terminates blind or is absent; the ureters open in the bladder, also the seminal vesicles, or, in females, the separately developed Müllerian ducts.
  2. With vesical cleavage: In the centre of the cleft bladder is the intestinal opening; on the sides, the opening of the ureters, and seminal vesicles, or vagina.
  3. With closed bladder: Rectum absent (atresia ani); rectum communicates with urinary or genital canal.
- Hernia peritonealis congenita: Congenital herniæ of the abdomen are characterized by dystocia of the abdominal viscera. They originate in the bulging of a less resistant portion of the peritoneum, which forms a hole or fissure in the abdominal wall. External and internal abdominal herniæ are to be differentiated. The former are visible from without, and resultant from outward bulging of the abdominal wall. The latter are not perceptible externally.

External abdominal herniæ are:
  H. inguinalis interna, media, externa.
  H. cruralis, ischiadica, perinealis, vaginalis, foraminis ovalis, umbilicalis, and abdominalis.

Internal abdominal herniæ are:
  H. diaphragmatica, retroperitonealis, mesenterialis.

The majority of these are acquired. Congenital varieties are:

H. inguinalis externa (outward from the arteria epigastrica, following the spermatic cord).

H. umbilicalis: In the fœtus a loop of ileum lies within the navel opening.

C. Atresiæ: Result from failure of canalization of solid areas of cells, destined to become hollowed out, to form sacs and tubes.

Atresia of pylorus, intestines, ureters, urethra, Fallopian tubes, uterus, vagina, hymen.

Atresia through failure of the skin to bulge toward, and open into, perfectly formed canals.

Atresia oris, ani (usually associated with atresia of vagina, urethra, or seminal vesicles).

Atresia through closure of orifices: Vulva, nose, ear; of the vagina and hymen, either total or partial absence of the former from obliteration of the Müllerian ducts. Occasionally there is an imperforate diaphragm immediately behind the hymen.

D. Various other embryonic conditions, without corresponding external evidence of the anomaly:

1. Diverticula: Of the intestines are congenital widenings or bulgings of the gut; remains of the ductus omphalomesentericus, from the time of communication of the intestines with the umbilical bladder (allantois). Meckel's diverticulum lies in the inferior segment of the ileum, on the convex side, opposite the mesentery, about one metre from the Bauhinian valve. It is occasionally connected with the navel by the obliterated ductus omphalo-mesentericus.
2. Cryptorchismus: Is the fœtal condition. Dystocia of one or both testicles, usually one, the organ remaining in the abdominal cavity. Descent of testes begins about the third month, these organs entering the processus vaginalis during the seventh month. This anomaly is usually associated with microschismus.
3. Congenital luxations: Slipping of the head of the joint out its socket, from arrested development of the latter.
4. Club-foot: Pes varus, equino-varus, flat-foot, pes valgus, planus, equinus, also the combinations equino-varus and equino-valgus, pes calcaneum, also talipes-manus—club-hand.

In pes varus the outer edge of the foot is turned backward, the sole inward; in valgus the inner edge of the foot turns under, the sole points backward, the back forward; in calcaneus the heel looks backward, the sole forward. The fœtal placing of the feet corresponds nearly with pes varus; this position is readily observed in the new-born.

Persistence of a fœtal condition, arrest of, or overdevelopment, and pressure in utero, also muscular contracture of centric origin, are causes of these anomalies. Talipo-manus is occasioned by rudimentary development of the radius.

Monstra Per Excessum.

Malformations characterized by over-large, over-heavy, and supernumerary development.

I. Over-large development:

1. Giants, macrosomia: Apparent before birth, or commencing immediately after. Affects in the main the bony skeleton and muscular system. Sexual function is very often suppressed.
2. Abnormally large single parts:
   Acromegalie (Marie): Enlargement of the pointed parts of the human body, hands, feet, nose, lips, chin, tongue, later the lower extremity; the distal portion of the forearm, lower jaw. The hypertrophy begins in youth or middle life, affects the bones and soft parts, and is always associated with muscular weakness, sensory disturbances, cephalalgia, and loss of memory, also dimness of vision and anæmia. According to Friedreich and Erb, this lesion is seen in several members of the same family.
   Macrocephalus; hydrocephalus (apparent cerebral hypertrophy, actual atrophy); macroglossia; macrodactylia; dermatocele adnata (sac-like, fold-forming hyperplasia of skin); excessive size of thyroid, thymus (asthma thymicum), of the ovaries, omentum, mesentery (occasions sometimes twisting and incarceration), of the intestines, ureters, clitoris, penis, uvula.
3. Abnormal development of hair, and pigment (hirsutio adnata, hypertrichiasis).

I. Supernumerary formation:

A. Monstra duplicia, twin formation; general or partial duplication of the body. Either both twins are equally developed, or one is stunted and is parasitic to the other, more or less normally developed autosite, from which it is nourished.

Duplication of upper portion of body: Terata anadidyma.

1. Diprosopus: Double face, one body, two fused, incomplete heads (brain absent).
2. Dicephalus: Double head; one body, two heads.
3. Ischiopagus: Two upper bodies, a common pelvis, two or four lower extremities. (Fig. 231.)
4. Pyopagus: Two nearly separate bodies; sacrum, coccyx, rectum, and occasionally the vagina single.

Duplication of lower portion of body: Terata catadidyma.

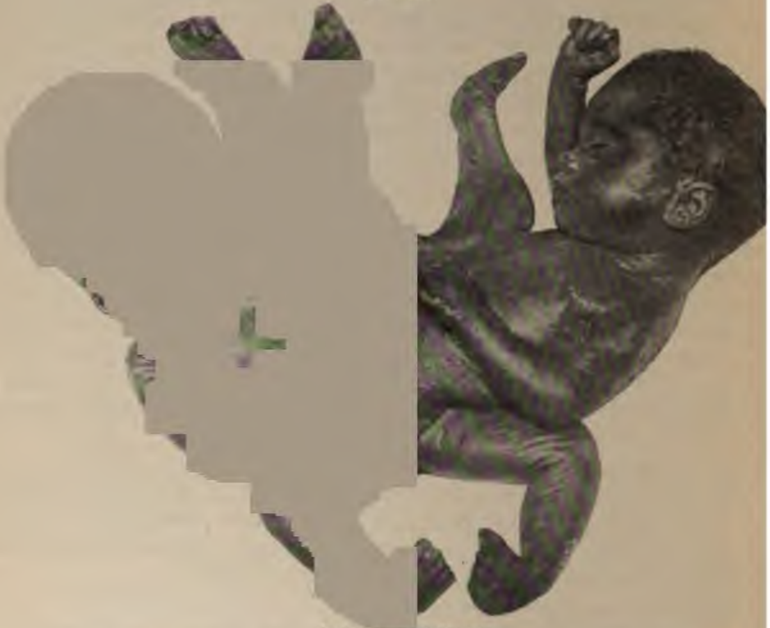
1. Dipygus: Double body, one head.
2. Syncephalus (Janiceps): Two individuals fused together by head and hips.
3. Craniopagus: Two bodies fused on heads, and often shoulders.

Duplication of upper and lower ends of bodies: Terata anacatadidyma.

1. Prosopothoracopagus: Skull cavities separated, under jaws developed, breast and neck fused.
2. Thoracopagus: Fusion of thoraces of two otherwise fully separate individuals (Siamese twins).

3. Epignathus: Prosopothoracopagus parasiticus: Fœtus in fœ The parasite is associated with the mouth of the autos usually the hard palate, and projects from the mouth.
4. Epigastrius: Thoracopus parasiticus: Fœtus in fœtu. Para attached from ensiform to navel of autosite.
5. Engastrius Abdominal inclusion of the parasite.
6. Rachipagus: Connection of two individuals at only one poin the vertebral columns; head, neck, a part of thorax, and l extremities duplicated.

FIG. 231.



Ischiopagus tetrapus.

Mother, a full-blooded Indian, delivered by Dr. Felipe Martinez, San Francisco, Cal.

B. Monstra triplicia: Triple monsters; are exceedingly rare.
C. Supernumerary extremities:
   1. Polymelia: The number of entire or half extremities is incr
   2. Polydactylie: The number of fingers or toes is increased.
D. Supernumerary organs. Practically all the separate organs be increased in number.

Monstra Per Fabricam Alienam.

Anomalous position of parts or organs:

1. Situs transversus, inversio viscerum. Rare. Consists in plete transposition of otherwise healthy organs.
2. Dystopiæ of separate organs.
   Heart: Dextrocardia, ectopia cordis, in thoracic fissure.
   Bladder: Ectopia vesicæ urinariæ in fissura abdominalis.

Spleen Stomach Liver Intestines	In hernia diaphragmatica congenita, and fissura abdominalis.

Ovaries: In inguinal region, or labia majora; anomalous descent.
Left kidney: In or on edge of pelvic cavity, or in the fovea inguinalis.
Caput coli on left side.
Colon descendens, median through radix mesenterii.
Great hepatic lobe on the left.

CHAPTER XV.

PATHOLOGY OF THE FŒTUS.—Continued.

DISEASES OF THE FŒTUS.

Pathological conditions of the fœtus are classified as follows:

Hereditary disease;
Developmental errors;
Acquired disease;
    Nutritional errors;
    Parasitismus;
Trauma from
    1. Local pressure effects;
    2. External violence.

Heredity. Recent advances in cytology have done much to throw light upon the subject of inheritance of disease, especially in the cytology and the *modus operandi* of the fertilization of the ovum. The classical researches of Flemming, van Beneden, Bovari, and O. and R. Hertwig have proven for all time that fertilization of the ovum consists essentially in the fusion of an exact quantity of nuclein or chromatin from the spermatozoid, with a similar quantity of the same substance in the ovum. The resulting segmentation of the ovum must produce cells whose constituent elements are a combination of chemical—vital—materials from both male and female progenitors. This mechanical theory abundantly explains the remarkable reproduction in the offspring of striking characteristics of either or both parents.

In the light of present knowledge it is impossible to formulate accurately the ultimate changes of a pathological nature occurring in those morphologic elements whose union is to produce a new entity; it can merely be assumed that they are essentially chemical—vital.

It must be that if the reproductive elements of either or both parents be impaired or altered in their nature, the change will inhere in the fœtus, and will be more or less evident, depending upon the condition of the other parent and his or her power to offset the deficiency. This theory of heredity holds equally for disease as for personal characteristics. The question thus arises, can such diseases as tuberculosis and syphilis be properly hereditary? Assuming both to be of parasitic origin, they cannot, in view of what has just been stated. Any heredity in these diseases must consist in regressive changes in the reproductive elements of one or both individuals, whereby the offspring is deprived of the power to resist invasion of the parasite, and offers a suitable soil for its propagation. The frequent skipping of a generation in tubercular families supports this view, as it goes to show that in the union of a tuberculously inclined individual with a perfectly healthy one, the peculiar lack in the reproductive elements of the one is counterbalanced by the normal elements in the other, to the extent of producing immunity in the *immediate* offspring.

In general, it may be said that heredity in disease consists in alteration of quality, quantity, or both, of the original elements of fertilization; which alteration persists in the fertilized ovum, and tends to limit its normal development, and inaugurates pathological processes in the fœtus. It cannot at present, however, be denied that these changes may be characteristic of certain diseases, such as tuberculosis, syphilis, and alcoholism.

Fœtal Infection. It is proved that the fœtus in utero may suffer infection. The infection may originate from the mother, father, or both, and may be simple or mixed. Its origin may also be external, in the sense that the secretions of the genito-urinary canal of an otherwise healthy mother may become contaminated with septic organisms from douche tubes, etc., which invade the fœtus through the liquor amnii (Menge and Krönig).

Fœtal infection is acute or chronic. Of the acute processes, scarlatina, measles, smallpox, recurrent fever, and erysipelas are recorded, together with septic and pyæmic infections, where pathogenic organisms were recovered from the organs and tissues of the fœtus. Death and expulsion of the fœtus are usual in these cases.

Of the chronic infectious processes tuberculosis and syphilis are the chief. Malarial lesions of organs have been described without discovery of the plasmodium. Fœtal infection occurs through the utero-placental tissues, the cord, and the liquor amnii. Normally the latter has strong germicidal properties, which may, however, be destroyed.

Any area of the fœtal body may become infected. The determining factors are: the primary source of the infection, the resistance of different tissues, the nature of the infecting organism. The organic lesions will correspond with the pathogenesis of the infecting germ. Erysipelas, multiple abscess, and gonorrhœal ophthalmia are examples of acute parasitic infections. Tuberculosis and probably syphilis are examples of chronic infection.

Inflammation. Acute inflammatory processes are infectious in their nature. They are important from their tendency (1) to destroy important structures, as the eye in gonorrhœa; (2) to limit development, as in hare-lip consequent upon inflammatory adhesion of the amnion to the fœtal face; (3) to produce death of the fœtus, as in erysipelas. Of the chronic inflammatory processes tuberculosis and syphilis are most prominent and best understood. Congenital hydrocephalus is a consequence of chronic meningeal inflammation.

Hæmorrhage. Prenatal hæmophilia is recorded. Aside from the hæmophilic diathesis, hemorrhage will result from the septic condition and trauma.

In sepsis the hemorrhages are usually petechial, and may be widely distributed. Very valuable evidence of the existence of sepsis lies in the finding of numerous very small petechiæ in the subserous tissues. Small hemorrhages may also be caused by cardio-vascular disease or anomaly.

Traumatism will produce large hemorrhages into the cavities of the brain, thorax, and abdomen.

Cephalhæmatoma results from pressure effects.

A. Jacobi asserts that small cerebral hemorrhages may occur in the fœtus, which, primarily unnoticed, produce ultimately epilepsy.

The writer has autopsied several cases of fatal cerebral hemorrhage in stillbirths, or deaths a few hours post partum, occurring in Dr. Jewett's service at the Long Island College Hospital, which originated from a cardiac anomaly described below.

Malnutrition. This condition in the fœtus may be due to heredity (*vide supra*), or to disease of the utero-placental tissues or the cord. It may result from an abnormally large quantity of amniotic fluid or the reverse of this, also from imperfect development of an organic system, as, *e. g.*, microcephalus, or general vascular hypoplasia.

Specific diseases, particularly tuberculosis and syphilis, will cause profound fœtal malnutrition, resulting often in death. In marked cases the fœtus presents the general appearances of atrophy, the face looks old, and the skin is loose.

Fœtal Death occurs during any period of gestation. Very soon after conception it will be followed by total absorption of the products. Later it will give rise to mole. In the later months of pregnancy the dead fœtus will undergo maceration, putrefaction—which may involve the mother in sepsis—mummification, or calcification. The dead fœtus may be retained in the uterus for years. Dr. Lusk reported a case in which a normal labor was followed fourteen years later by the removal of a calcified fœtus.

Fœtal death is caused by hereditary disease, acute infectious diseases, fœtal tuberculosis, syphilis, and malnutrition. It is also caused by utero-placental disease, and by twisting and knotting of the cord, by hyper- and oligohydramnios, and by trauma.

Diagnosis of Death of the Fœtus. The diagnosis is difficult in the early months of gestation. The intra-uterine temperature of the mother is always higher than the vaginal while the fœtus is alive. An equal or lower temperature in a uterus containing the product of conception is probable evidence of fœtal death. On bimanual examination the uterus presents a boggy feel. Pelvic tenesmus is usually present in some degree.

The death of the fœtus can, as a rule, easily be determined when it has occurred after the period when fœtal movements are perceptible. The most reliable signs are the persistent absence of fœtal heart-sounds and of fœtal movements. The abdomen ceases to enlarge; the breasts become flaccid and diminish in size.

A fetid discharge from the vagina containing exfoliated epidermis is a certain indication of the presence of a dead fœtus. Should the fœtal head present at the pelvic inlet the cranium is found to be soft, and the cranial bones loose and movable, overlapping one another. The lips of the dead fœtus in a face presentation are flabby and motionless. No *caput succedaneum* can form during delivery, as there is no fœtal circulation to make it possible. Large quantities of meconium may be discharged, though the breech does not present. Yet this frequently occurs during the birth of a living child. Should the breech present, the examining finger will discover that the anal sphincter does not contract. Should the umbilical cord prolapse, it will be found flaccid and pulseless.

Infection of the mother from the dead fœtus in utero is extremely apt to occur, and its presence is indicated by depression, furred tongue, chilliness, fever, a pale and sallow color.

Errors of Development. Minor malformations, as hare-lip, supernumerary fingers, etc., are *Anomalies;* major malformations, as anencephalus, involving a considerable portion of the fœtus, are *Monstrosities.* Up to the time of Lemerey, Winslow, and A. v. Haller, monsters were regarded as wonders of evil omen.

Winslow and Haller regarded developmental errors as primary anomalies of the seed, present in it before fertilization; while Lemerey regarded them as due to interference with the processes of embryonic development.

As embryology became better known, J. F. Merckel and Geoffroy-Saint-Hilaire, father and son, treated the whole subject of teratology more thoroughly, and called attention to the relationship between arrest of normal development and persistence of the fœtus in a certain stage of development.

Förster was the first to collect and classify the literature on this subject; and, following him, Ahlfeld rearranged and extended it in a series of plates. (Thoma.)

Many interesting experiments have been made by such investigators as Geoffroy-Saint-Hilaire, Panum, Dareste, L. Gerlach, the brothers Hertwig, Roux, and others, with the result of proving that anomalies in embryonic development may be induced by mechanical means, such as separation of the elements of the segmenting ovum and axial change of its position during segmentation. These facts show the influence of environment upon fœtal development. Thoma, of Dorpat, draws attention to the fact that twins occurring from a single ovum develop circulatory disturbances in the nature of venous obstruction, with hepatic and other organic congestions due to anastomosis of the vascular systems of both individuals. Others have produced twins in the ova of *rana* by permanently inverting the primitive streak.

Notwithstanding all the brilliant work in this direction, we still know but little regarding the etiology of anomalous development. It is pretty clear that heredity, malposition of the blastoderm, intoxications and infections of the fœtus in utero, all play a part in the arrest of development, as well as oligohydramnios and trauma.

As Thoma well puts it, fœtal disease *per se* is also significant in the production of anomalies: as increase of amniotic fluid, œdema of the embryonic tissues, organized adhesions between the fœtal tissues, and between these tissues and the amnion, and even isolation of areas of embryonic tissue, *e. g.*, dermoid cyst.

The same author also justly remarks that aside from gross errors in development, giving rise to extensive deformity, it is very important to remember that anomalies may obtain in single organs, which in time will produce secondary disease. Many aplasiæ will make life impossible to the child after birth; others will handicap it, and still others will constantly menace its existence. Practically those anomalies which tend to limit the possibilities of the child after birth are of greater importance to it; while monstrosities are of greater importance to the mother in the often grave complications they occasion during parturition.

Systematic Organic Lesions. There is not space in an article like this for a detailed description of all the lesions of the fœtal organs. In general, it may be said that the fundamental principles underlying these lesions are identical with those governing lesions in the adult, the one difference being rather of result—*i. e.*, arrest or alteration of development in many instances in the fœtus. In describing some of the more important organic diseases, only such minor anomalies will be considered as tend to induce other pathological conditions.

Heart. Endocarditis is almost always in the right heart; is rarely acute, usually chronic, and due to syphilis.

Myocarditis is acute (from infection, Menge and Krönig), or chronic, and due to syphilis. In the latter case it is interstitial.

Endocarditis, with anomalous or incompetent valves may produce a vicious circulation, and chronic venous hyperæmia; cases are reported in which typical nutmeg-liver and renal cyanosis complicated this lesion. Hemorrhage, marked or slight, may also be caused by it, and may involve any organ, notably the brain and lungs. Through the courtesy of Dr. Jewett, the writer has been able to autopsy several stillbirths and infants dying a few hours after birth in the maternity wards of the Long Island College Hospital, in which it was revealed that the pulmonary artery was immediately confluent with the thoracic aorta (through a large and persistent ductus arteriosus?), with extremely small branches running to the lungs. The right ventricle was hypertrophic. Aside from a few petechiæ in the subserous tissues generally, all of the cases showed very considerable hemorrhage at the base of the brain and around the medulla and pons. In all the parturition was normal, with not the slightest evidence of sepsis. In some of the cases there was pulmonary hemorrhagic infarct. In these cases, if the ductus arteriosus be regarded as the source of confluence between the pulmonary artery and the thoracic aorta, its structure was unusually thick, and in every way similar to the other portions of the vascular channel at this point. The writer believes that this may be a more common condition than is generally supposed.

According to Orth, who recites a very remarkable instance, hypoplasia cordis, with general vascular hypoplasia, is a very important fœtal condition, bearing direct relation to chlorosis in the young. His patient, a girl in her teens, died with marked chlorosis, and the autopsy revealed an infantile heart with an aorta that scarcely admitted an ordinary lead-pencil within it. It is probable that this condition may cause fœtal malnutrition not infrequently.

Tachycardia and arrhythmia are caused by nervous anomaly, general cardiac insufficiency, systemic fœtal infection, uterine pressure, and fœtal debility.

Tuberculosis is rare, and always discrete.

Bloodvessels. Anomalies of the vascular distribution are directly responsible for lack in development of entire parts, as, *e. g.*, a cerebral hemisphere.

Hemorrhage is by rhexis from cardiac lesion, or trauma, pressure in utero, efforts to respire before or during parturition, and hæmophilia, and by diapedesis in sepsis, icterus neonatorum, and probably hæmophilia. The hemorrhage of sepsis is very important, as it affords a point in diagnosis of the condition. The hemorrhage is always multiple and petechial, or at least small, and most conspicuous in the subcutaneous and subserous tissues.

Vasculitis. Acute vascular inflammation may supervene in the fœtal bloodvessels, and involve the adventitia or intima, or be diffuse; but the most important inflammatory changes are chronic, and due to syphilis. Here there is active, small round-cell infiltration, with hyperplasia of *connective tissue.* Either the outer or inner, or both, coats are involved; and the lumina of the vessels may be diminished and eccentric. It cannot be doubted that such chronic vascular inflammations may arrest development, and, by inhibiting osmosis, produce profound nutrition disturbances.

Finally, microscopic examination of the tissues of fœtuses suspected to have died of infection has yielded positive results to a number of investigators. The writer, through the courtesy of Dr. Jewett, observed a multiple hepatic infection in an infant dying shortly after birth, where microtome sections revealed numerous foci of small round-cell infiltrations, and, amongst these cells and in the intralobular capillaries, micrococci. Menge and Krönig record a case in which septic anaërobes were found in the right heart of a stillbirth, where the liquor amnii had become infected.

Hyperplasiæ and aneurisms of the arterioles, capillaries, and venules are common, and form verrucose nævi and so-called birth marks.

Lymphatics. These structures are the seat of inflammation and are associated with the lesions of elephantiasis fœti. They are often angiomatous, and are common carriers of micro-organisms.

Lungs. Pulmonary œdema and hemorrhage occur as results of cerebral and cardio-vascular lesions, pressure effects in parturition, trauma, and sepsis. Hæmothorax from trauma is recorded. Atelectasis is normal until birth; it persists after birth from prenatal centric lesions and defects, or obstruction of the respiratory tract with inhaled mucus. It is partial or total.

Disseminated pneumonia is frequent in fœtal infection.

Syphilis gives rise to "white pneumonia" (Osler) and interstitial and vascular hyperplasia.

The writer has seen undoubted septic pneumonia in several cases of stillbirth in puerperal sepsis. Cross section of these lungs revealed characteristic areas of infiltration, which microscopic examination proved to be foci of small round cells, whose centres were in coagulation necrosis. Pleuritis has been recorded.

Spleen. Aside from anomalies, this organ will show the characteristic changes of sepsis, and, it is claimed, of malaria.

Primæ Viæ. Acute inflammatory lesions may obtain from infection. Menge and Krönig find evidence of it in cases where infection from the amniotic fluid apparently started in the stomach and intestines. Tuberculosis and syphilis occur in the stomach and intestines, and the mesenteric and retroperitoneal glands.

Of the anomalies, one or two are liable to produce trouble later in life. The writer has autopsied three cases of fatal perforative appendicitis where *situs transversus* was found. The caput coli in one case was literally transposed; in the other two it was displaced, and closely adherent to the sigmoid flexure. Diverticulæ are seen in any part of the canal, and may be sufficiently large to produce serious trouble. The stomach may be nearly inverted, and the cardia brought lower than the pylorus; or it may assume a vertical position. Gastric hypoplasia may be marked.

Atresia ani and recti may be of sufficient degree to prove fatal, or may be amenable to operation.

Liver. Reveals characteristic structural changes incident to cardio-vascular lesions and the parenchymatous changes of septic infection. It may be the primary focus of infection in the fœtus, the source of which is the cord or the liquor amnii. (Menge and Krönig.)

Icterus neonatorum will result from such infections, and may be complicated with fatal hemorrhage.

The writer has seen, and Menge and Krönig report, cases in which microtome sections revealed foci of small round cells, micrococci in the writer's case, and a short bacillus in those of Menge and Krönig.

Kidneys. Aside from their interest merely as curiosities, the renal anomalies are very important from their relative frequency and the bearing they have on surgery. A single kidney may be developed, or the two may fuse to form a horseshoe, or both may locate in the pelvis. One or both organs may be destroyed by hydronephrosis due to atresia of the genito-urinary canal at some point.

All of the changes due to renal cyanosis may be present as results of cardio-vascular lesions. These organs also show the general changes of infection; and localized areas of infection have been found, especially in the Malpighian pyramids (Menge and Krönig).

A very important congenital condition of the kidney, described by Orth, Rosenstein, and others, is multiple cystic degeneration of the cortical tubules. According to Rosenstein the crypts may be so numerous as to leave but little functionating tissue. The cysts never attain a large size. The condition is often accompanied with renal hemorrhage, and is, unfortunately, usually bilateral. The writer has seen one such case which came to operation for renal hemorrhage and tumor. The right kidney was very large, weighing about three pounds, and studded with hundreds of cysts, which varied in size from a pullet's egg to that of a pin-head. In this case both organs were involved, and the patient died of uræmia. The etiology of these cystic kidneys is very obscure. Not infrequently an infant dies within a few days after birth, and the kidneys are found to contain uric-acid infarcts, which are located, as a rule, in the medullary portions of the collecting tubules. According to Ziegler these infarcts form after birth as a result of the inability of the renal parenchyma to sustain the increased work thrown upon it.

Genital Organs. Aside from anomalies, the organs of generation may be the seat of infection, which is acute or chronic, depending upon the nature of the infection.

Osseous System. Osteomalacia, premature ossification, general hyperplasia, and infections of various nature occur.

"Spontaneous fracture" has been recorded, and is regarded as due to uterine contractions and trauma.

Luxations of the joints are due to anomalous development or oligohydramnios.

Oligohydramnios is in causal relation with talipes or similar conditions.

Centric Talipes. Centric lesions will also produce them by causing muscular contracture.

Muscular System. Aside from anomalies of development, the muscles ct to the same changes occurring in other tissues due to general

kin shows the characteristic lesions of acute specific diseases, such tina, smallpox, erysipelas, etc. Syphilitic and tubercular lesions o been observed.

ıa, ichthyosis, and many other lesions of the skin have been l; but, as yet, their pathology is entirely obscure.

CHAPTER XVI.

ABORTION AND PREMATURE LABOR.

Definition and Classification. The term *abortion* signifies the expulsion of the products of conception before the sixteenth week of gestation, at a time when the placenta is not yet fully formed, and hence when it cannot be expelled or expressed (Credé's method) in its entirety.

Premature labor is applied to the delivery of a fœtus at any period from the time after it has become viable to within a few weeks before the normal termination of pregnancy. It is made to cover the period from the twenty-eighth to the thirty-sixth or thirty-eighth week of gestation.

For the intervening period (from the sixteenth to the twenty-eighth week) not included by abortion and premature labor, the term "*miscarriage*" is generally employed. The use of the latter term, though sanctioned by time and habit, is not satisfactory, as admitted by many authors who have submitted to the custom. It would appear that the term "*immature labor*" would be more appropriate. The processes of expulsion at this period of gestation resemble in a measure those of labor at full term, and they may be looked upon as constituting a labor in miniature. But the fœtus, though it may be born alive, is so immature in its development that it cannot be reared—in other words, it is non-viable. Hence, the adjective "immature" would fitly denote at once the nature of the delivery and the condition of the fœtus.

Viability of Fœtus. Assigning the twenty-eighth week as the period of viability is somewhat arbitrary; for with the modern incubators and improved methods of feeding, fœtuses born at an earlier period of pregnancy have been known to live and thrive.

Ribemont-Dessaignes and Lepage[1] make the weight of the fœtus a criterion of its viability. They consider it non-viable if it weighs less than 1000 grammes, and viable if it weighs more than that. French authors make the following divisions: (1) *Ovular abortion*, that which takes place before the twentieth day. (2) *Embryonic abortion*, that which takes place from the twentieth to the eightieth day. (3) *Fœtal abortion*, that which takes place from the fourth to the seventh month. This division is confusing and has no practical value.

Abortion is artificial or spontaneous according as it is or is not evoked intentionally.

Artificial abortion is spoken of as *therapeutic* when it is done for justifiable cause, and *criminal* when it is done for improper or immoral reasons.

Frequency. It is generally stated that from 30 per cent. to 40 per cent. of all married women abort before they reach the age of thirty years. But it is next to impossible to ascertain reliable statistics on this point. Many women abort at an early period of pregnancy without knowing it, thinking that the menses were merely delayed and then came on rather profusely. Again, other women conceal the fact from motives of delicacy. The estimates of authorities differ widely. According to some writers, abortion occurs once in five or six pregnancies. Hegar[1] estimates the frequency as once in eight pregnancies. M. Bossi[2] states that to every one hundred pregnancies at full term there are twenty-five abortions.

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[1] Ribemont-Dessaignes et Lepage. Précis d'Obstétrique. Paris, 1897.

Whitehead,[3] whose statistics are universally quoted, states that thirty-seven out of every one hundred mothers abort before they reach the age of thirty years. His statistics, however, were based upon the lowest classes of Irish peasants, who were living in Manchester in great privation and amid most insanitary surroundings, and with whom very early marriages were the rule.

Time of Occurrence. Abortion occurs most frequently in the third month—that is, between the ninth and sixteenth week of pregnancy. This is generally the case when it is due to diseases and malpositions of the uterus, as chronic endometritis and backward displacements. It is especially liable to take place at the menstrual dates. It is very probable that this greater frequency at the third month and in the beginning of the fourth month is due to the fact that at this time important changes are taking place in the attachment between the ovum and uterine wall. It is the period of the formation of the placenta. The chorionic villi situated on the periphery of the ovum undergo atrophy, while those situated in contact with the uterine wall (the decidua serotina) become hypertrophied.

The extent of surface by which the ovum is attached to the uterus is, therefore, decreased, though at the point where it still remains attached —the site of the future placenta—it strikes deeper roots into the uterine tissues. When syphilis is the cause the pregnancy is more likely to be interrupted at the sixth, seventh, or eighth month of gestation.

It is commonly believed that early, especially first, pregnancies have more frequently a premature termination than those which come after. Whitehead[3] observed, however, that the third and fourth pregnancies and one or two of the last, those, namely, which occur near the termination of the fruitful period, are most commonly unsuccessful. This is particularly interesting, inasmuch as Whitehead's observations relate to a class of people among whom the girls married at the early age of thirteen and fourteen years. This experience corresponds with that of the author with Russian Jews, who also are given to early marriages.

Etiology. It may be stated, as a general law with some exceptions, hat all etiological factors act either by exciting uterine contractions irectly, or indirectly by causing the death of the fœtus, which in turn followed by uterine contractions. For practical purposes the causes abortion may be divided into those acting through the father, those ting through the mother, and those affecting the ovum.

PATERNAL. By far the most important and frequent cause of aboron proceeding from the father is syphilis. It is frequently overlooked cause the manifestations of the disease may no longer be present, or they may never have been so marked as to excite the attention either of the patient or his physician. Tuberculosis, lead-poisoning (C. Paul,[1] Rennert[2]), alcoholism, extreme youth, great old age, excessive venery, may all act as causative factors. Ribemont-Dessaignes and Lepage[3] relate an observation which would go to prove that excessive coition may be a cause of abortion. Of thirty cows that were served by the same bull within a short period, the fifteen that were served first went to full term, the last fifteen all aborted.

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[1] Hegar. Monatsch. f. Geburtsh., Bd. xxxi. S. 31.
[2] M Bossi. Annali di Osteticia et Ginecologia, No. 2, 1898.
[3] Whitehead. Abortion and Sterility, etc. London, 1847.

MATERNAL. (*a*) *Acute infectious diseases*, especially typhoid fever, influenza, smallpox, cholera, scarlatina, measles, pneumonia, and acute intermittent fever. The more severe the affection, and the higher the fever and the more continuous it is, the more likely is abortion to occur. The germs may act directly on the fœtus through the placental circulation, or the attendant high temperature may destroy the fœtus (M. Runge[4]), or placental hemorrhages may occur as a result of the pathological changes set up by the constitutional affection (Zweifel[5]).

(*b*) *Chronic infectious diseases:* tuberculosis, syphilis, and severe malarial poisoning (T. G. Thomas[6]). Of these, syphilis is again by far the most common cause. According to Roemheld,[7] 27 per cent. of all interrupted pregnancies are due to syphilis in the mother.

(*c*) *Organic diseases:* cardiac affections, especially those of the left orifice (A. McDonald,[8] E. Leyden[9]); chronic nephritis, causing white infarcts of the placenta and premature separation of the placenta.

(*d*) *Constitutional affections:* diabetes mellitus, progressive pernicious anæmia, lead-poisoning (Benson-Baker,[10] Rennert[11]), acute anæmia following sudden great loss of blood.

(*e*) *Emotional disturbance:* sudden shock, severe fright, profound sorrow, etc., may at times bring about the interruption of pregnancy.

(*f*) *Traumatism:* this as a cause of abortion must always be accepted with considerable scepticism. In a healthy condition of the uterus and the ovum the pregnant woman may sustain the severest injury without aborting. On the other hand, when the utero-placental vessels are fragile, as they are in some constitutional diseases—*e. g.*, syphilis—a slight traumatism, such as is occasioned by a fit of coughing, straining at stool, retching and vomiting, may be attended by a hemorrhage between the placenta and the uterus, and consequent abortion. A severe blow on the abdomen after the third or fourth month, when the uterus has risen into the abdominal cavity, may act as an exciting cause, either by causing the death of the fœtus directly or by bringing about a separation of the placenta from the uterine wall. In these instances, as a rule, the symptoms of abortion follow immediately the receipt of the injury. The laity, however, are only too prone to ascribe the interruption of pregnancy to the most trifling accidents, such as a misstep or a simple fall.

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[1] C. Paul. Arch. gén. de Médecine, 1860.
[2] Rennert. Arch. f. Gyn., 1881.
[3] Ribemont-Dessaignes et Lepage. Précis d'Obstétrique. Paris, 1897.
[4] M. Runge. Volkmann's klin. Vorträge, No. 174, and Arch. f. Gyn., Bd. xii. S. 16.
[5] P. Zweifel. Lehrbuch der Geburtshülfe, Stuttgart, 1895.
[6] T. Gaillard Thomas. Abortion. 1890.
[7] L. Roemheld. Inaug. Diss. Mainz, 1895.
[8] A. McDonald. Obstetrical Journal of Great Britain, 1877.
[9] E. Leyden. Zeitsch. f. klin. Med., 1893.
[10] Benson-Baker. Obstet. Trans., London., 1867, vol. viii. p. 41.
[11] Rennert. Arch. f. Gyn., 1881.

Major operations (ovariotomy and even myomectomy) have been perxmed on pregnant women without any deleterious influence upon the ourse of gestation. Operations on the vulva, however, are said to be ore dangerous in this regard (Schauta[1]). Yet the author once excised a ery much hypertrophied hymen, necessitating extensive suturing of the esulting wound, in a young woman in the fourth month of pregnancy, nd she went to full term.

Too frequent indulgence in sexual intercourse not only lessens the irility of the spermatozoa, as we have already seen, but acts also as a aumatism and brings about a hyperæmia of the uterus. Hence, aborion is common in newly married women during the first five or six weeks of married life.

Sea voyages, even in absence of storms, and high altitudes (Sancerotte and Jourdanet, quoted by Charpentier) are said occasionally to cause premature expulsion of the fœtus.

Drugs. Certain drugs—ergot, savine, quinine, salicylate of sodium (the author[2]), and a host of others—are supposed to possess the property of bringing on abortion. It is doubtful whether they can do this in a normal condition of the uterus. When a strong predisposition exists, however, quinine and salicylate of sodium should be administered with great caution.

Local Causes. Backward displacement of the uterus is a very common cause (58 per cent., Roemheld[3]), in which condition it may be due to the inability of the fundus to rise above the promontory, and then it usually takes place between the third and fourth month. The termination of pregnancy may, however, occur later, and then it is said to be due to the chronic endometritis and metritis that are usually associated with the malposition.

The other conditions of the uterus that may give rise to abortion are chronic metritis, chronic endometritis, laceration of the cervix, mutilation of the cervix through an unskilful amputation, adhesions of the uterus to the pelvic wall or to other adjacent structures, fibromyomata or malignant growths, immature and abnormal development of the uterus (uterus bicornis, pregnancy taking place in a rudimentary horn), neighboring tumors, and pelvic deformities, which may interfere with the growth of the uterus. Artificial forward fixation of the uterus, ither to the vagina or to the abdomen, has been known occasionally to roduce abortion from inability of the fundus to grow, owing to too irm union with the vaginal or the abdominal walls. Marked disease f the adnexa may interrupt the pregnancy.

Habitual Abortion: Lastly, there are some women who abort over d over again, and in whom the most thorough investigation fails to d a reasonable cause. To this condition the term "habitual abortion" applied. To attribute the tendency to a hyperæsthetic condition of uterine system of nerves (T. G. Thomas[4]) or to congestion of the rus (Napier[5] and others) is merely begging the question. By many hors the term habitual abortion is used interchangeably with repeated abortions. This is misleading from an etiological standpoint, to say the least.

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[1] Friedrich Schauta. Lehrbuch der Gesammten Gynäkologie, Leipzig und Wien, 1896.
[2] H. N. Vineberg. New York Med. Journ., vol. lix. p. 785.
[3] L. Roemheld. Inaug Diss. Mainz, 1895.
[4] T. Gaillard Thomas. Abortion. 1890.
[5] W. D. L. Napier. Trans. London Obstet. Society, 1890, p. 389.

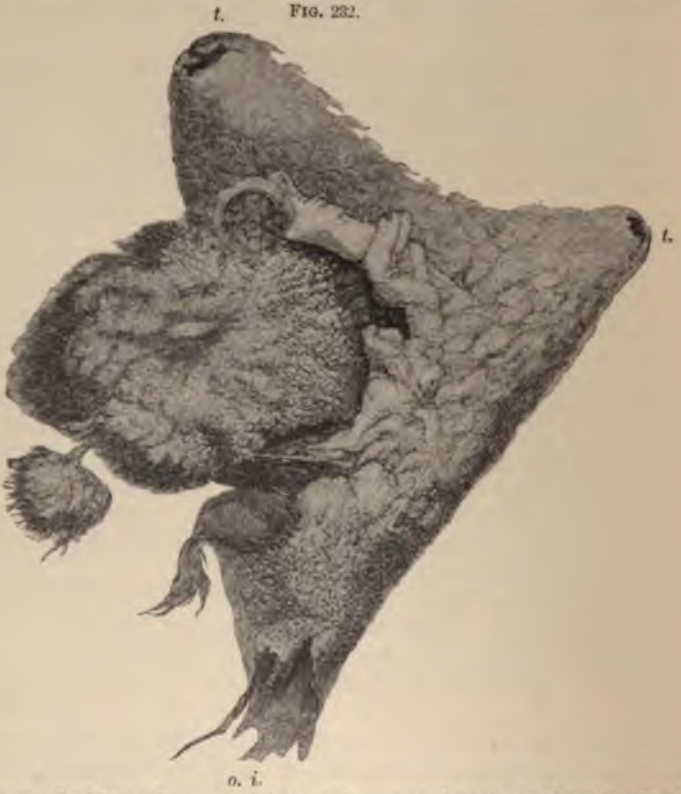
FŒTAL. Under this heading are included all the pathological changes that may affect the ovum and its envelopes. Here, again, syphilis plays an important *rôle* by producing changes in the ovum or in the placenta which lead to the death of the fœtus and to consequent abortion. It may kill the fœtus directly through causing marked pathological changes in important organs, and the membranes may remain unaffected (Zweifel[1]).

Syphilis may be transmitted directly from the father, and the fœtus die of it without infection of the mother ensuing. According to Napier,[2] when syphilis is the cause, the death of the fœtus occurs most frequently between the third and eighth months, very seldom before that time.

Various diseases of the decidua, placental apoplexy, and the different degenerations of the placenta may bring about abortion by causing death of the fœtus. Polyhydramnios, by causing over-distention of the uterus, may lead to premature expulsion of its contents.

Abnormal insertion of the placenta (placenta prævia) is very prone to

FIG. 232.



Aborted ovum. Deciduæ and ovum complete. *o. i.* corresponds to the decidua situated at the os internum; *t. t.*, to the decidua situated at the openings of the tubes.

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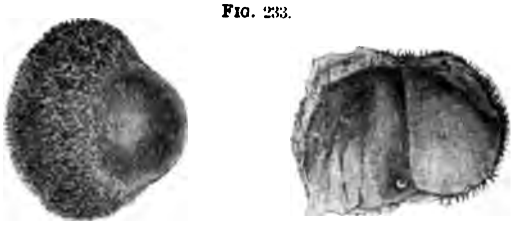
[1] P. Zweifel. Lehrbuch der Geburtshülfe, Stuttgart, 1895.
[2] W. D. L. Napier. Trans. London Obstet. Society, 1890, p. 389.

induce abortion, though it generally plays a more important *rôle* in the production of premature labor.

Pathology. To describe all the pathological changes of the membranes and ovum that are observed in abortion would lead us beyond our province. We will merely give those that we consider necessary for the elucidation of our subject.

In abortion there is invariably a rupture of the bloodvessels that connect the ovum and the uterine wall—in other words, of the utero-placental vessels. The effusion of blood usually takes place in the decidua vera, but not infrequently it forces its way between the decidua and chorion, also at times even breaking through the decidua and amnion and filling the amniotic cavity with blood. In abortions of more advanced pregnancy, after the formation of the placenta the blood is effused between the placenta and the uterine wall. In this manner the placenta is detached to a greater or less extent from its uterine insertion. In studying the pathological anatomy and mechanism of abortion we cannot do better than quote Dr. Berry Hart's[1] excellent description: Two forms must be considered: (1) Normal or complete; (2) abnormal or incomplete.

FIG. 233.



Closed. Open.

Ovum of the first month. The deciduæ have remained behind, the amnion has broken through the chorion ; natural size. (WINCKEL.)

Normal or Complete. There are two varieties depending upon the size of the ovum proper covered by reflexa. In the first variety, when the ovum is small, the decidua is separated in its whole extent and is expelled with the ovum. This is the exception.

In the second variety the decidua vera separates over the lower uterine segment, and the ovum proper is covered by reflexa driven down into the cervical canal, but remaining attached above by an apparent neck to the decidua of the retracting upper segment. The rest of the decidua is then separated and the whole expelled.

Abnormal or Incomplete. The following two varieties may occur:

1. The fœtus alone or the entire ovum with its chorion may be expelled through the reflexa. The decidua vera and reflexa are retained or expelled later.

2. The ovum covered by reflexa may be expelled, the apparent polypus neck having been snapped. The part thus expelled is often mistaken by the practitioner for the entire ovum. He sees an oval sac covered by decidua with amnion below this and containing liquor amnii and the fœtus. It is really only the ovum proper covered by reflexa, and the decidua vera and serotina in the shape of a sac are still *in utero*.

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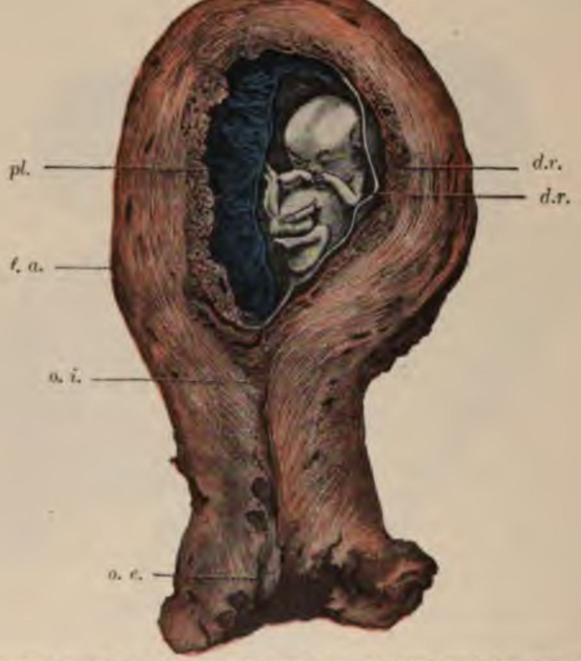
[1] D. Berry Hart. Trans. Edinb. Obstet. Society, 1890-'91, p. 20.

It happens occasionally that the extravasation of blood into the membranes takes place at different times, allowing the coagulation of the blood in strata, thus forming what is known as a *blood mole*. Should the process of abortion be slow in culminating, the coloring matter of the blood becomes absorbed, the blood strata undergo partial organization, and there results what is known as a *fleshy mole*. This may form anew a connection with the uterine wall and be retained for an indefinite period. These *moles* have generally a characteristic appearance, being covered with the decidua serotina and reflexa, and having remnants of the decidua vera hanging from them. On cutting them open the fœtus or ovum is found in the centre of a smooth-lined cavity—the amniotic. The fœtus is very small in comparison with the size of the expelled mass, and may be overlooked unless searched for with a magnifying glass.

In incomplete and neglected abortions the retained portions of decidua or of placenta may develop into a decidual or placental polypus in the following manner. The uterus, through contractions, endeavors to expel its contents, the placental residua are thus loosened in some places and hemorrhage occurs. The blood is deposited upon the placental remains in layers, forming a smaller or larger polypoid mass, which acquires a new connection with the uterine tissues. Decidual polypi are formed

FIG. 234.



Early pregnancy (two months). *o. e.*, os externum; *o. i.*, os internum; *f. a.*, upper limit of firm attachment of peritoneum; *pl.*, placenta; *d. v.*, decidua vera; *d. r.*, decidua reflexa. (HOFMEIER.)

in exactly the same way (Winternitz[1]). These polypi may remain for weeks, or even for months, in the uterus without undergoing decomposition and without causing a fetid discharge or elevation of temperature. Winternitz[2] relates a case that came under his treatment six and one-half months after the abortion. The removed mass was free from any fetid odor. It is these formations that frequently are the cause of irregular hemorrhages, continuing for a long time after a supposed complete abortion.

The retained placental and decidual residua do not always behave in this benign manner. They may undergo decomposition, and if the drainage is not free, as is most frequently the case, owing to the closure of the cervix, septic infection of a more or less serious nature may result.

The fœtus in cases of abortion is, as a rule, smaller than the period of pregnancy would indicate. This is particularly true of cases of fleshy mole, where the ovum dies at an early stage. It may then become entirely absorbed, or exist merely as a small white strand in the centre of the amniotic cavity. In other cases, after undergoing partial maceration in the liquor amnii, the fœtus may become mummified, and be thus expelled, or, again, putrefaction may set in and the putrid mass be expelled piecemeal.

Symptoms and Clinical Course. The symptoms of abortion vary at different periods of pregnancy. In the first six or eight weeks, prodromal symptoms are rare. The woman has not yet, as a rule, experienced any of the symptoms of pregnancy. The abortion has all the characters of a retarded and profuse menstruation, which the patient often thinks it is. She loses considerable blood, and frequently passes large clots. Her suffering generally is not great—not more severe than that which ordinarily accompanies menstruation. Skene[3] speaks of some cases in which the hemorrhage takes place only at night when the patient is lying down. The explanation he offers is that the ovum dies and is not expelled, but acts as a valve at the os internum when the patient is in the erect position. When, however, "she lies down, it falls away from the os, and a hemorrhage takes place, the blood accumulating in the uterus when she is standing or walking about." At times there may be considerable uterine colic. If the woman recognizes the fact that she has been pregnant she will often state that "everything" has come away in the form of a large fleshy mass, which is usually nothing more than a large blood-clot partially organized. At this stage generally the ovum is rarely found; it passes off with one of the clots, or with the shreds of the decidua.

On bimanual examination the uterus is found enlarged, especially in its antero-posterior diameter, to about double the size of the non-pregnant uterus. The cervix may be quite closed or very slightly open.

In other cases the cervix will be found quite open, and the finger will detect just beyond the external os a smooth, globular, elastic mass, apparently attached to its interior. This, as we have already seen, is the ovum driven into the cervix, but arrested in its expulsion by the strong muscular fibres of the external os.

In a third class of cases the uterus will be found slightly, if any

[1] E. Winternitz. Sam. Zwanglos. Abhand. aus dem Gebiete der Frauenheilk., Bd. ii. Heft 4.

[2] Ibid.

[3] A. J. C. Skene. Medical News, 1884.

larger than normal. The continuance of the hemorrhage in these cases will furnish us the only evidence that all the products of conception have not yet been expelled. It is important to bear in mind that, though the uterus is not enlarged and the cervix is not patulous, the hemorrhage in all probability is due to retained decidua, for it is generally stated that retained decidua is always indicated by a patulous cervix. We have seen cases in which profuse hemorrhage continued for weeks with the local conditions just mentioned, and which were due to the presence of a fragment of decidua, perhaps not larger than the finger-nail. Dührssen,[1] who has had a very extensive experience as the assistant of Gusserow at the Charité in Berlin, says that "the retention of portions of the decidua vera is not the exception, but the rule."

In a very small percentage of cases where the ovum and its membrane are virtually expelled, either *en masse* or separately, the hemorrhage ceases in four or five days, and a local examination will detect merely a softened uterus, perhaps slightly enlarged.

After the second month of pregnancy premonitory signs are generally present. The patient will complain of bearing-down sensations in the lower part of the abdomen, and she will suffer more or less from a feeling of weight in the pelvis, from backache, from frequent micturition, and from a slight mucous or watery discharge. Pains resembling labor pains may precede any marked hemorrhage, though at times there may be considerable loss of blood before labor pains are experienced. The further advanced the pregnancy the more likely will it be that the labor pains will precede the hemorrhage, though the opposite may obtain at any period of prematurity.

On local examination the cervix may be found closed or partially open, according to the advance the efforts of the uterus have made to expel its contents. The uterus will be found to correspond in size with the given period of pregnancy, providing the fœtus has not yet been expelled. The latter fact is readily ascertained from the woman herself or any of the attendants, as the fœtus has now reached a stage of development which makes it easily recognizable by the laity.

The placenta may be expelled entire after the delivery of the fœtus, or it may come away piecemeal—a much more frequent occurrence. In the latter class of cases portions of the placenta may remain attached to the uterus for an indefinite period, as already stated, causing from time to time uterine hemorrhage. In cases of protracted abortion the woman shows signs of ill health. She grows more or less anæmic, has a somewhat haggard appearance, and feels too weak to carry on her usual duties. Of course, in cases of incomplete abortion, when the retained products undergo decomposition and septic infection occurs, the usual symptoms of sepsis manifest themselves, and the temperature usually runs high. It must be borne in mind, however, that we may have a severe form of sepsis with scarcely any elevation of temperature. These cases are generally very treacherous, as the poison acts chiefly on the heart.

Locally we may find an exudate in Douglas's cul-de-sac or at the base of one of the broad ligaments. In other cases there will be the local signs of pelvic peritonitis.

In abortions prior to the second month there is no true lochial discharge, but rather a sero-sanguineous flow lasting three or four days. In the later months the flow resembles more or less that following labor at full term, and the more advanced the pregnancy the closer the resemblance. After-pains are not common until after the fourth month. Before that period they are usually due to incomplete expulsion of the products of conception.

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[1] Dührssen. Archiv f. Gyn., Bd. xxxi. Heft 2, S. 161.

Involution takes place in less time than after labor at term. Subinvolution and the consequent metritis, however, are more common, owing to the neglect of the precautions usually observed after normal parturition.

Diagnosis. At first thought the diagnosis of abortion would seem to be an easy matter, but the practitioner will meet with no condition in his practice which at times will puzzle him to the same degree. In some cases the diagnosis is a simple affair. A woman who has always been regular passes one or two menstrual periods, then suddenly is seized with profuse hemorrhage, and on examination the cervix is found dilated and the finger comes into contact with a globular body—the ovum lying within it. Unfortunately, from a diagnostic point of view, such a combination of conditions is a rare exception. The first two conditions may be met with, but on examination the cervix will be found closed and the uterus but slightly enlarged. The questions confronting the examiner then would be: (1) Has the woman been pregnant? (2) Has she aborted? (3) Is the abortion complete or incomplete? Amenorrhœa in a married woman who has always been regular and who is not nursing is strong presumptive evidence in favor of pregnancy. Other signs should be looked for. A uterus perceptibly larger than the non-gravid organ would confirm the diagnosis of abortion. The third question could be answered only by the presence or absence of hemorrhage, for with very few exceptions the hemorrhage will continue more or less irregularly so long as any portion or fragment of decidua or placenta is retained in the uterus. It is true that in some cases the presence of retained products within the uterus will be manifested by a patulous cervix, which will readily admit the index finger beyond the os internum, but the opposite condition, a closed cervix, obtains just as often.

The occurrence of hemorrhage in the pregnant state is always significant of threatened or actual abortion. But such hemorrhage, *more especially if it be slight*, may be due to other causes. A visual inspection of the cervix with the aid of a speculum ought to be made to ascertain whether the blood does not come from an erosion of the cervix, from carcinoma, or from a small cervical polypus. In some women there is a periodical flow for the first two or three months or more of pregnancy.

Ectopic gestation may be mistaken for abortion. At times nothing but a careful bimanual examination (under narcosis if necessary) will serve to differentiate the two conditions.

The points of distinction are: (1) The genital hemorrhage in ectopic gestation is more irregular and usually less profuse than in abortion. (2) The pain in ectopic gestation is generally more severe, and has the characteristics of severe colic more than of labor pains. (3) In ectopic gestation the patient is likely to suffer from syncopal attacks when rupture takes place, and at every recurrence of hemorrhage into the peritoneal cavity.

(4) The mass formed by an ectopic sac is, as a rule, much more sensitive to pressure than an imprisoned gravid fundus uteri.

It occasionally happens that the gravid uterus enlarges irregularly on account of adhesions or of chronic metritis. As this condition is likely to lead to abortion sooner or later, it may give rise to the erroneous diagnosis of ectopic gestation (Vineberg[1]).

In very obscure cases, seeing that symptoms of abortion are present, there can be no objection to fully dilating the uterus under narcosis and exploring its cavity with the finger.

Prognosis. The menace to life in spontaneous abortion is very slight, but abortion is often the starting-point of serious trouble.

The *dangers* are:

(*a*) *Hemorrhage:* Although this is seldom so severe as to endanger life, yet the woman may be markedly weakened by the loss of blood, which may persist for weeks if not arrested by proper treatment. Occasionally, however, it may be so profuse as to cause death (Zweifel[2]).

(*b*) *Subinvolution:* This may result in chronic metritis and endometritis, which may lead to invalidism.

(*c*) *Septic infection:* This rarely occurs from retained products unless the woman has been examined by unclean hands, or had an unclean instrument passed into the uterine cavity. In the writer's experience, however, abortion in sharply retroflexed uteri is rather prone to be attended with septic infection. This, no doubt, is due to the circumstance that drainage is very markedly interfered with. Sepsis following abortion is not, as a rule, so serious a condition as that following labor at full term. On promptly emptying the uterus the septic manifestations, as a general rule, readily subside. An exception, however, must be made in cases of sepsis following criminal abortion. Here the course of the affection may be virulent and rapidly fatal.

Treatment. *Prophylactic.* In order to succeed in the preventive treatment a very thorough investigation must be made of each case with a view to ascertaining the cause, and the treatment suitable for the condition found must be instituted.

If retroversion be present, a suitable pessary should be introduced after the uterus has first been replaced to its proper position. The case should be carefully watched, especially during the third month and the commencement of the fourth, when the fundus rises out of the pelvis. After this the pessary may be removed. Chronic endometritis and laceration of the cervix call for appropriate treatment, which, of course, must be carried out before conception takes place. When uterine adhesions are the cause careful massage and stretching of the adhesions followed by suitably placed tampons, may be attended with success.

The pelvic massage may be carried out even during pregnancy; th manipulations, of course, must be conducted with the greatest gentle and caution.

If syphilis be suspected—and in cases of doubt as to causation it always wise to suspect it—both parents should be subjected to a lo continued course of antisyphilitic treatment, and in the mother treatment should be continued during the whole pregnancy.

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[1] H. N. Vineberg. New York Med. Journ., vol. lix. p. 785.

[2] P. Zweifel. Lehrbuch der Geburtshülfe, Stuttgart, 1895.

Nervous diseases, such as chorea, etc., must be combated by the proper remedies.

In cases of habitual abortion, without any ascertainable cause, the woman should be enjoined to remain in bed during the time when the menses would normally recur. The rest in bed should be absolute, the patient not being allowed to get up to void urine or feces. Emotional excitement of all kinds should be prevented. Zweifel[1] states that he has met with success in some cases by entirely interdicting sexual intercourse during the whole pregnancy. Some authors speak favorably of the internal administration of potassium chlorate. The writer has met with apparent success with this form of treatment in a few cases. The salt is administered in five-grain doses, freely diluted, three times a day, and is to be given during the whole period of gestation. It is said to act by diminishing uterine irritation and congestion, and also by increasing the oxygen of the blood in the mother (Sir J. Y. Simpson[2]). Viburnum prunifolium has been highly lauded in habitual abortion by E. W. Jenks.[3] He advises from a half teaspoonful to a teaspoonful of the fluid extract four times a day, beginning at least two days before the menstrual date, and continuing it for two days longer than the periods usually last. Pregnant women in whom the habit of abortion exists should not be allowed to go on long railroad journeys, nor on a sea voyage. In these cases it is best that at least a year elapse after the last abortion before pregnancy again occurs. Physiological rest of the sexual organs for a long period occasionally has a happy effect.

Treatment of Threatened Abortion. The abortion may be arrested so long as the death of the ovum has not occurred. But as it is next to impossible to determine this point, we are forced to act, in great measure, empirically. If the hemorrhage has been moderate, more particularly if the cervix has not yet dilated to any extent, we should direct our efforts to staying the threatening event.

It is rarely that we will meet with success after dilatation of the cervix to the extent of admitting the index-finger has taken place. Still, even with this degree of cervical dilatation our efforts may occasionally be rewarded by seeing the process arrested, the cervix close again, and the gestation go on to full term.

The patient must be put to bed in a cool, darkened room and absolute rest enforced. She should not be allowed to sit up for any purpose whatsoever. The diet should be bland and cool. No one but the nurse and one other attendant should be admitted into the sick-room. The remedy which forms the sheet anchor in this class of cases is opium in some form. A good way of administering it is in the form of rectal suppositories, each containing one grain of the aqueous extract. One may be slipped into the rectum every four or six hours. If, when first seen, the patient is suffering severe pain it is good practice to administer at once a hypodermic injection of morphine (gr. one-sixth to one-fourth). Viburnum prunifolium in half-drachm or drachm doses every six or eight hours acts as a sedative to the uterus and constitutes a valuable adjunct to the opium treatment. If the hemorrhage is profuse the patient's hips should be elevated by a couple of pillows, and cold cloths cautiously applied to the vulva. The application of ice-cold cloths to the hypogastrium is not advisable, owing to the danger of exciting uterine contractions. The same objection applies to the employment of vaginal tampons or gauze packing.

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[1] P. Zweifel. Lehrbuch der Geburtshülfe, Stuttgart, 1895.
[2] Sir J. Y Simpson. Obstet. Memoirs, Edinburgh, 1865, vol. i. p. 460.
[3] E. W. Jenks. Trans. Amer. Gyn. Soc., vol. i. p. 130.

The foregoing treatment should be continued until all hemorrhage and pain have entirely disappeared for at least two days. Great caution should be exercised after the cessation of the symptoms in allowing the patient to be up and about, or to resume her duties. On the reappearance of the slightest discharge of blood or on the return of the pains, the patient should be made to go back to bed at once.

When the threatened abortion is due to the incarceration of the fundus below the promontory, the patient should be placed in the knee-chest position and the cervix and vaginal vault exposed by lifting up the posterior vaginal wall with a good-sized Sims's speculum. The cervix is then caught with a tenaculum and gently drawn forward and downward while pressure is made against the fundus in the proper direction with a large wad of cotton held in an ordinary uterine dressing-forceps. In the majority of cases the manœuvre will succeed in releasing the fundus and making it clear the promontory. A couple of large, firm tampons should then be placed in the posterior vaginal fornix to maintain the fundus in the proper position. It may be necessary to repeat this treatment daily for several days, until all danger of the fundus falling back into the faulty position has disappeared. The patient need not necessarily stay in bed.

Treatment of Inevitable Abortion. When, in spite of the foregoing treatment, the symptoms persist and the abortion becomes inevitable, or when the case at the outset shows evidences that it would be useless to attempt to arrest the process, our plan of treatment must be different. There is no further need of keeping the patient under so rigid restrictions.

The treatment of actual abortion still seems to be a disputed field. Some authorities (Dührssen,[1] Fehling[2]) strongly urge active interference at once. Others (Lusk, Winckel) favor an expectant plan of treatment, and would only interfere as necessity arises from hemorrhage or sepsis. It is the writer's custom to follow a course of action which lies about midway between these two apparent extremes.

For the purposes of treatment it is well to divide the cases into *early abortion* (before the tenth week) and *late abortion* (from the tenth to the sixteenth week).

When called to a case of *early abortion*, and there is evidence that the ovum has already escaped, and there is but a slight flow of blood which has lasted but a few days only, we can afford to wait a day or two longer to see whether the hemorrhage will entirely cease of itself. Of course, there must be an entire absence of febrile symptoms. The patient should be kept in bed, and the administration of ergot (ʒss t. i. d.) is advisable. While the total expulsion of the ovum and its membranes *en masse* is an exceptional occurrence, still in a fair proportion of the cases in which the ovum breaks through its envelopes and is expelled alone or with portion of the decidua the remaining portions of the decidual resid are cast off either by uterine contractions or with the scant lochial secretions that follow.

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[1] Dührssen. Archiv f. Gyn., Bd. xiii. Heft 2, S. 161.
[2] Fehling. Archiv f. Gyn., Bd. xiii. S. 222.

In the same class of cases, if the hemorrhage be profuse, or even if it be scanty, but has continued now and then for several days, the proper course to pursue is to curette without further delay. In these cases, as a rule, the hemorrhage is due to retained decidua which is firmly adherent to the uterine tissue, and no amount of uterine excitants will stimulate the uterus to such a degree as to enable it to extrude the decidua. It is just in these early cases that it is often difficult to know whether the ovum has already been cast off or not. When in doubt in this regard it is good practice to decide in favor of curettage at once.

The operation when properly done—and every practitioner ought to know how to do it properly—is so free from danger and accomplishes the object in view so satisfactorily that the benefit of the doubt may be cast in its favor. The facts should always be plainly stated to the patient, and if she elects to wait to see what nature (perhaps with ergot) will accomplish, she must do so on her own responsibility. During the waiting period, if the hemorrhage be at all profuse, the vagina should be tightly packed with iodoform gauze, which may be left *in situ* for twenty-four or forty-eight hours. It must not be forgotten that all contact with the interior of the vagina must now be carried out under strict aseptic or antiseptic precautions.

In another class of cases, forming only a very small percentage, at the first examination the ovum is found enveloped in some of its membranes lying in the cervical canal.

In some of these cases the ovum is easily removed by hooking the finger above it and drawing it down ; in others again, the external os is so rigid and unyielding that its lips may have to be cut before the ovum can be extracted. An ordinary placental forceps will at times prove very serviceable in seizing the ovum and twisting it off as one would an ordinary polypus. In the majority of these cases any further interference will be unnecessary. But if the hemorrhage should not promptly cease after the above procedure the uterus should be subjected to a thorough curettage.

In a third class of cases there may be unmistakable evidence, in the circumstance that the uterus corresponds in size to the period of gestation, that the ovum and all its membranes are still within the uterine cavity. Two courses are offered: (1) To anæsthetize the patient, forcibly dilate the uterus with branching dilators, and thoroughly empty the uterus, be it with the fingers alone or with the curette alone, or with a combination of both; and (2) to pack the cervix and vagina with iodoform gauze, and wait for twenty-four or forty-eight hours to see if nature will be able to complete the process. The author's custom is to adopt the first course, unless the patient strenuously objects to it. The objection that may be raised against this plan of treatment is that it usually necessitates reliance upon the curette alone, as it is not often that the cervix can be dilated to the extent that one or two fingers may be passed into the uterine cavity. Should any one, however, not have sufficient confidence in his skill to use the curette in this manner, the second course may be pursued in part. The packing can be made to serve the double purpose of arresting the hemorrhage and dilating the cervix. After the lapse of twenty-four or forty-eight hours the cervix will usually be found to have undergone sufficient dilatation to admit one or two fingers, with which the greater part of the uterine contents may be removed. The gentle use of the curette will succeed in bringing away the remainder. The employment of any form of tents to dilate the cervix is unsafe and unreliable practice.

A great deal of discussion has taken place as to the relative merits of the finger and the curette for emptying the uterus in abortion. It really matters little which is used, so long as the products of conception are totally removed. In a great number of cases it is impossible to obtain such dilatation of the cervix as to admit the introduction of one's finger. On the other hand, even when the finger can enter the uterine cavity it is not often possible by this means to bring away all the contents. In these cases it is the writer's practice to remove as much as possible with the finger, and then to supplement it with the use of the curette, employing the finger from time to time to ascertain if there is still anything left behind.

In *late abortions* the general line of treatment resembles more or less closely that just described. At this period, however, we do not meet with the same difficulty in determining in a given case whether or not the fœtus has been expelled. It is no longer possible for it to escape without exciting the notice of the patient or the attendants. If the fœtus be still within the uterus it is a good plan to pack the vagina with iodoform gauze, pushing as much of the gauze within the cervix as possible, even should the hemorrhage be not profuse. The cervical and vaginal packing has the effect of exciting uterine contractions, bringing about cervical dilatations, while at the same time it forms a safeguard against the occurrence of hemorrhage. At the end of twenty-four hours the packing should be removed, and if the cervix be found dilated the uterus should be emptied with the patient fully anæsthetized. In extracting the fœtus care should be taken not to tear the trunk away from the head, the delivery of which may occasion considerable difficulty. This accident, however, will happen at times, no matter how careful we may be. It is a good plan in these cases to depress the uterus with one hand above the symphysis, and thus fix the round ball-like body, while with the finger or fingers of the other hand in the uterus a hole is bored into the head, which thus being hooked into may be easily extracted. When it cannot be thus delivered it may be easily broken up with the fingers and removed piecemeal. In carrying out these manœuvres care ought to be exercised not to lacerate the soft uterine walls, an accident that need never occur, and one which the author has never met with, although he has resorted to this course on several occasions. The secundines in the majority of cases can next be removed with the fingers in the uterus, being aided by the other hand above the pubis, with which the uterus is depressed and held in a steady position. When the secundines cannot all be removed in this manner, the interior of the uterus may be gently scraped with a large partly sharp curette—Mundé's or Lusk's (H. J. Garrigues[1]).

If it be found that the fœtus has already been delivered, but that the secundines are still retained, the latter should be removed at once in the manner just described, without waiting for the occurrence of hemorrhage or sepsis before interfering. If the cervix be not sufficiently dilated, forcible dilatation should be practised, either with the finger or a steel divulsor.

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[1] H. J. Garrigues. The Medical News, Nov. 6, 1897.

In all cases after emptying the uterus its cavity should be thoroughly irrigated with plain sterilized water, lysol (1 per cent.), carbolic acid (2 per cent.), creolin (½ per cent.), or corrosive sublimate (1 to 2000 or 3000). When using the latter agent an irrigation with sterilized water should follow. The toxic effects of corrosive sublimate solutions are due not so much to absorption during the irrigation as to the fact that a certain amount of fluid always remains behind in the uterus and is in part absorbed before it can drain away.

Septic infection: At all periods and in every stage of abortion where there are any indications of sepsis, as manifested by elevation of temperature and rapidity of the pulse, or by a too rapid pulse, the temperature remaining normal or only slightly above it, active interference is called for at once. A day's delay, or even one of several hours, may allow a mild sepsis to develop into one of a serious nature such as may be beyond our power to control. As a general rule, the sepsis that occurs in the course of an abortion is readily amenable to the proper treatment, which consists in emptying the uterus thoroughly, and following this up with irrigations along the lines already laid down. An exception to the above rule is the sepsis occasionally seen in criminal abortions, which may run as *foudroyante* a course as the severer sepsis following labor at full term.

Should the symptoms of sepsis not subside completely under the foregoing plan of action, the uterine cavity should be irrigated again, and the irrigations be repeated every four, six, or eight hours, according to the severity of the case. It will also be necessary to dilate the cervix from time to time, as it has a strong tendency to contract, and thus interfere with free drainage. Packing the uterine cavity in these cases is absolutely to be avoided, and even a strip of gauze in the cervix to favor drainage is, in our opinion, a snare and a delusion. There still seems to be a fear lurking in the minds of some distinguished authorities (Lusk,[1] Garrigues,[2] and others), that curetting a highly septic uterus will destroy the protective wall which nature forms, the so-called "granulation zone" of Bumm.[3] The fear is founded upon a supposed fact which does not in reality exist. The "granulation zone" was observed by Bumm only in the milder cases of sepsis, in the so-called cases of "putrid intoxication;" in the severe forms of infection no such protective zone was seen, but the micro-organisms were found penetrating the whole thickness of the uterine wall and on the peritoneum. If Bumm's observations were to guide us in our clinical work we would refrain from curetting the *mild* cases of uterine sepsis, while in the severe forms they would constitute no contraindication, for we could not destroy that which did not exist. But as a matter of fact the cases in which a well-marked "granulation-zone" was observed were the very cases which had been curetted, and which were promptly benefited by the curettage.

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[1] Wm. T. Lusk. The Amer. Journ. of Obstetrics, 1896, vol. xxxiii.
[2] H. J. Garrigues. The Medical News, Nov. 6, 1897.
[3] E. Bumm. Archiv f. Gyn., Bd xl. Heft 3, S. 398.

The patient from the outset should receive the general treatment usually applied to septic conditions following parturition at term, and as this is fully described in another part of this treatise, it will be unnecessary to repeat it here.

Immature labor : The treatment of immature labor is the same as that for premature labor, which will receive attention later. There is probably a greater tendency for the placenta to be retained in the uterus than when pregnancy is interrupted at a more advanced period. If there be no hemorrhage, nor any elevation of temperature, and the pulse is normal, there is no harm in waiting twenty-four or forty-eight hours to see if the uterus will of itself be able to expel the placenta. But to tampon the uterus and vagina during this period, as recently recommended by Garrigues,[1] would seem to be an unsafe procedure and one likely to favor sepsis. If such a contingency arise in country practice much the safer plan is to remove the placenta manually at once should attempts to express it by Credé's method fail.

The patient might be seized with a dangerous hemorrhage in the physician's absence, which might prove disastrous before he could reach her. Beside, there is a prevalent prejudice among the laity that is not entirely unfounded against leaving the after-birth in the uterus for any length of time after the fœtus has been delivered.

Curettage. The operation of curetting the uterus may now be described. The description may be premised by saying that the same care in asepsis and antisepsis ought to be exercised in regard to it as to that of any major operation. It is only by making this a routine in everyday practice that infection can be averted in cases which have not already been rendered septic. The operation should not be followed by rise of temperature in a clean case, and when it is, we must, as a rule, assume that we have introduced the pathogenic germs.

The patient should be placed upon a table in the lithotomy position. This can be attained by the various leg-holders in the market, or, in the absence of these, by twisting a sheet diagonally, tying one end around the thigh near the knee, making it pass over one shoulder and underneath the other, and tying the other end around the opposite thigh, both thighs being flexed upon the abdomen. The vulva and surrounding parts should be thoroughly scrubbed with an ordinary hand-brush and with warm water and green soap. Shaving off the hairs of the vulva may or may not be done. It is the writer's practice to do it. The hands should then again be washed before undertaking to scrub the vagina, which ought to be done thoroughly but not roughly. A gauze compress held in uterine forceps serves this purpose very well, aided from time to time with two fingers of one hand. There is nothing better to reach all the corners and crevices of the vagina than the fingers, or the half hand when there is a wide orifice. The vagina and vulva are then freely irrigated with sterilized water, which may be followed by an irrigation with some antiseptic solution. The legs should now be covered with sterilized cotton stockings or, what answers just as well, sterilized pillow-slips, and sterilized towels be placed upon the lower part of the abdomen, over the buttocks, and beneath the nates; in short, every part in the immediate vicinity of the operating field except the vaginal orifice should be covered with sterilized cloths. While this is being done by the nurse, the operator should again subject his hands to a thorough scrubbing and washing. A weight-speculum (Edebohls') retracts the posterior vaginal wall and exposes the cervix, which is seized with one or two volsellæ. No traction should be made with these, their purpose being merely to fix and steady the uterus. With one of the branching dilators the cervical canal is gradually dilated. Hegar's cervical bougies or Hanks' steel dilators may first be used, and the dilatation increased by the branching instrument. In some cases the cervix is very rigid, and to overcome this considerable force will be required; in others again, the tissues are very friable, and here the greatest caution must be exercised, or a serious tear extending into the uterus may be readily inflicted. After obtaining all the dilatation possible within safe limits, an attempt may be made to introduce the index-finger of one hand. The finger may be able to locate the situation of the retained products, and perhaps remove them. In this procedure the instruments should be removed and the uterus depressed with the other hand above the symphysis.

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[1] H. J. Garrigues. The Medical News, Nov. 6, 1897.

In many cases it will be impossible to dilate the cervix so that the finger may be introduced, as has already been stated. In these the curette alone will have to serve our purpose, and the sharp instrument is the one we invariably employ. Very many object to the use of a sharp curette as being too dangerous, and recommend a dull one. It seems to us that less harm is likely to be done with a sharp than with a dull instrument, for we can gauge the necessary force to employ more accurately with the former than with the latter. It must be admitted that the uterus may be perforated with either instrument, even in skilled hands, but ill results need not necessarily follow. When it is learned that the accident has occurred, the remainder of the uterus may still be curetted, care being taken to avoid the point of injury, and no irrigation should be employed. Should any inflammatory reaction follow, an ice-bag may be placed over the lower part of the abdomen and opium suppositories administered. There is no excuse for some of the serious accidents that are occasionally reported. They are not inherent in the operation, but are due to a combination of brute force and gross ignorance on the part of the operator.

The three accidents reported by M. D. Mann[1] were due not to the use of the curette, but to the branching dilator, which in two of the cases evidently perforated the uterus when being introduced, and the perforations were increased in size by introducing forceps which seized coils of intestine. In Mann's[2] own case the tear in the uterus was effected with Goodell's dilators. Still he thoroughly curetted the uterus after the accident, and the patient made a good recovery. Why these cases should be used as a warning against the use of the curette, as Mann seems to imply, it is difficult to understand.

Injury to the uterus in curetting is more frequently inflicted by pushing the curette through the uterine wall than in the act of scraping. By bimanual examination the size of the uterus, and consequently the depth of its cavity, can be fairly well estimated. By this means also the direction of the canal can be ascertained. In introducing the curette, therefore, one ought to know in which direction to carry it and when it may be expected to reach the fundus. No force whatever should be employed in this manœuvre.

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[1] M. D. Mann. The Amer. Journ. of Obstetrics, 1895, vol. xxxi. p. 603. [2] Ibid.

Having passed the curette to the fundus the wall is scraped on withdrawing it, and one soon learns in which region of the uterus the retained products are situated. The curetting at this point may be done more vigorously, but a close watch must be kept upon the nature of the tissues removed. With a little experience one readily learns when the curette has reached the harder uterine tissue. In cases in which the uterus is very soft, the instrument, if a sharp one, need merely to be gently drawn over the surface. While the curette is being used, it is a good plan to apply one or two fingers of the other hand through the vaginal wall against that portion of the uterus which is being scraped internally. This steadies the wall of the uterus and aids us to gauge the force to employ. It is particularly in the cornua that decidual and placental residua are likely to be retained. These regions of the uterus, therefore, call for especial attention. When the operator feels satisfied that everything has been removed, the uterine cavity should be irrigated as stated above, but packing the uterus or the vagina with gauze ought to be avoided except in those instances in which uncontrollable hemorrhage follows the operation.

It is a good plan to administer ergot for the following four or five days or longer, in order to favor involution. The patient should be kept in bed for six or seven days, at the end of which time the uterus should be examined bimanually to ascertain if involution has progressed satisfactorily.

Missed Abortion and Missed Labor.

Missed Abortion. It occasionally happens that the fœtus dies and the progress of gestation ceases, but the products remain within the uterus for weeks or even months. To this phenomenon the term "missed abortion" is applied; a similar condition occurring when pregnancy has arrived at full term is called "missed labor."

Missed abortion must also imply a comparatively quiescent state of the uterus, in order to distinguish it from prolonged abortion (W. Japp Sinclair[1]).

As a rule, at the time of the death of the fœtus a slight hemorrhage occurs; but this may be absent, as it was in the three cases reported by Sinclair. It is seldom necessary to interfere manually in these cases. According to Sinclair,[2] "missed abortion" does not occur among young and presumably vigorous primiparæ. The writer's patient was young, but of rather delicate build, and had mitral stenosis. The same authority states that there is seldom a history of previous abortions or retentions in these cases; in our case there had been.

Missed Labor. In this condition there may or may not be some of the phenomena of ordinary labor at the time parturition should normally occur. If they do occur, the pains and the discharge are very slight, and soon cease.

The fate of the retained child varies very much. In some instances when the membranes are not broken and no atmospheric air enters the amniotic cavity, the fœtus may remain fresh for a long time; in others it becomes macerated and undergoes mummification. In other cases again, when atmospheric air does enter the cavity, putrefactive changes set in, giving rise to the condition known as *physometra*. Sometimes the soft parts of the fœtus disappear through liquefaction, and the bones are a long time in being discharged; sometimes they pass through the uterine walls and appear in the vagina, rectum, or bladder, or they set up in their passage an inflammatory process about the uterus, leading to a pelvic abscess.

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[1] W. Japp Sinclair. Brit. Gyn. Journ., 1887-'88, p. 201.

[2] Ibid.

It is generally recommended to wait a few weeks in cases of missed labor, in the hope that the uterine contents may come away of themselves without artificial interference. Should this plan be pursued the patient ought to be carefully watched, and on the slightest manifestations of fever or symptoms of sepsis the uterus should at once be emptied of its contents. One should always decide in favor of artificial interference as soon as there is positive evidence of the death of the fœtus. The woman is exposed to less risks by the adoption of this plan of procedure, carefully conducted, than she would be by carrying about a dead fœtus for an indefinite period.

In every case after the delivery of a dead fœtus, it is a good plan to follow the expulsion of the placenta and membranes with a copious intra-uterine douche of some mild antiseptic solution.

The administration of ergot for some days after the emptying of the uterus is particularly advisable, as the uterus in these cases has a tendency to inertia and retarded involution.

Premature Labor.

The factors already stated as being causative of abortion may likewise act at a later stage of gestation, and be the means of prematurely terminating the pregnancy.

The most common causes, however, are faulty insertion of the placenta, albuminuria, and syphilis.

In 357 cases analyzed by Vallais[1] faulty insertion of the placenta was present in 179 cases, albuminuria in 39 cases, and syphilis in 33 cases. In 82 cases no cause could be ascertained.

Treatment. When a woman is threatened with premature labor and the fœtus is still alive, one would naturally endeavor at first to avert it, unless there were marked albuminuria and threatening symptoms of an eclamptic seizure, or in the presence of a faulty insertion of the placenta (placenta prævia and placenta marginalis); in such contingencies one would, on the contrary, hasten the event. Opium must now be given with some caution, for fear of its unfavorable effect on the fœtus. A combination of potassium bromide and chloral hydrate (āā gr. xv.) acts well in these cases. Should one's efforts fail and the labor go on progressing, its management is precisely similar to that of labor at term, and hence does not call for special attention here.

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[1] François Vallais. Thèse, Paris, 1893.

CHAPTER XVII.

ECTOPIC GESTATION.

Definition. When an impregnated ovum becomes fixed and begins to develop outside of the uterine cavity, ectopic gestation or extra-uterine pregnancy is established.

Varieties. The classification of ectopic gestation into tubal, ovarian, and abdominal, made by Bianchi in 1741, and simplified by Boehmer in 1752, remains practically unchanged, as far as the primary forms are concerned, unto this day. The terms *primary* and *secondary*, as applied to ectopic gestation, refer to the conditions before and after rupture or change of location of the ovum. As will hereafter be shown, rupture and change of location occur in the majority of cases, the anatomical relations of the ovum to its surroundings being thereby altered. Cases of primary ovarian and abdominal gestation are so rare and so difficult of absolute demonstration, that the general statement may be admitted that every ectopic pregnancy is primarily tubal.

Tubal pregnancies are classified according to the site of attachment of the ovum as (1) interstitial, the so-called tubo-uterine; (2) true tubal, isthmial, or ampullar, and (3) infundibular or tubo-ovarian.

1. **Interstitial Pregnancy** refers to that class of cases in which the ovum develops in that portion of the tube which passes through the wall of the uterus, or in a diverticulum from that part of the tube.

2. **True Tubal Pregnancy** is the variety in which the ovum develops in the free portion of the tube, without protrusion into either the uterine or the abdominal cavity. When it occurs in the inner portion of the tube, it is termed *isthmial*, and when in the outer, *ampullar*.

3. **Infundibular Pregnancy** includes the cases in which the ovum is lodged and developed in the infundibulum of the tube, and prevents closure of its abdominal ostium. The cases of this variety in which the ovum is attached to the ovary are ordinarily styled tubo-ovarian.

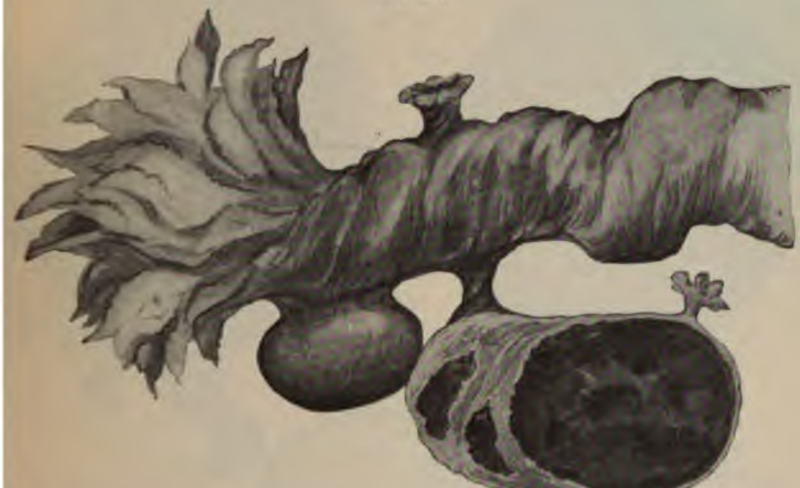
Ovarian and Abdominal Pregnancy are terms applied to those cases of extra-uterine pregnancy which are supposed to originate and develop in the ovary or in the abdominal cavity.

Anomalous Varieties. Ectopic pregnancy may occur in an accessory fimbriated extremity (see Fig. 235), or in a diverticulum from the Fallopian tube (see Fig. 236). Both of these varieties are to all intents and purposes tubal pregnancies.

Cornual Pregnancy occurs when the seat of gestation is in the undeveloped horn of a bicornate uterus. This anomaly is due to unequal development or lack of proper union of the two Müllerian ducts. Although cornual pregnancy in its course and termination resembles extra-uterine pregnancy, it cannot properly be classed as a variety of the latter, but is a true uterine pregnancy, which, by reason of the malformation of the organ, eventually becomes pedunculated and walled off from the main vity. It is, however, surrounded by uterine mucosa, and the decidua formed in the impregnated cornu.

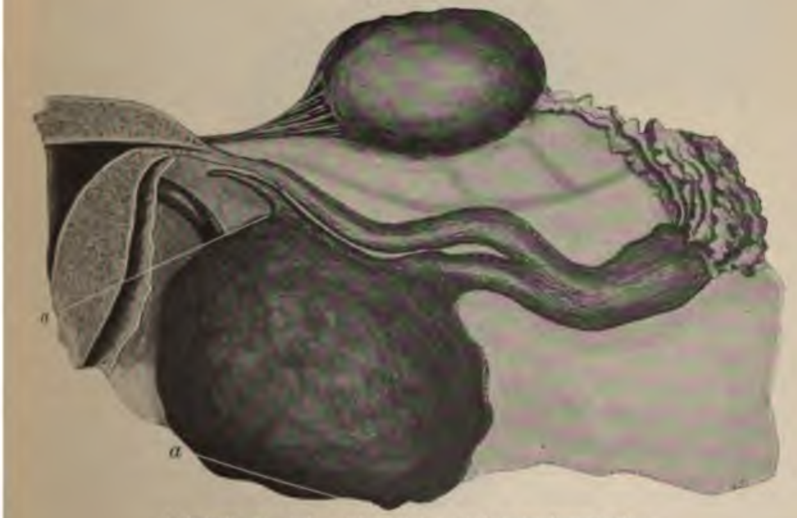
Any attempt to classify the secondary forms of extra-uterine pregnancy ds to confusion. In this connection the term *secondary* means subsequent to rupture or displacement. When an ovum breaks through its outer investing structures without rupture of the sac, its development is not necessarily arrested, although its anatomical relations may be

FIG. 235.



Ectopic gestation in blind accessory fimbriated extremity of right tube.

FIG. 236.



Left Fallopian tube with ectopic gestation in diverticulum.
a, a. Gestation sac communicating with diverticulum.

changed. A special name has been given to each of the varied locati of the displaced ovum, and to this fact is due the confusion of ter

FIG. 237.

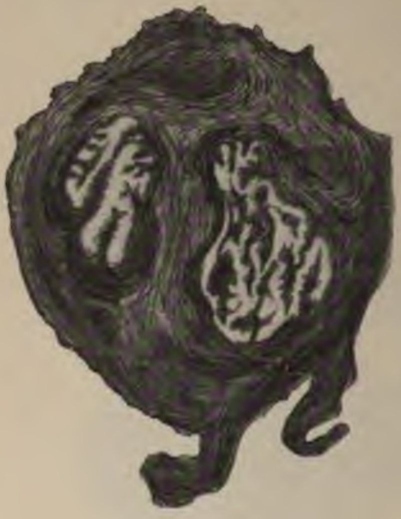


FIG. 238.

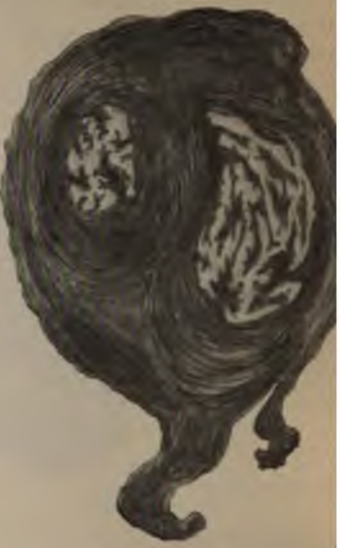
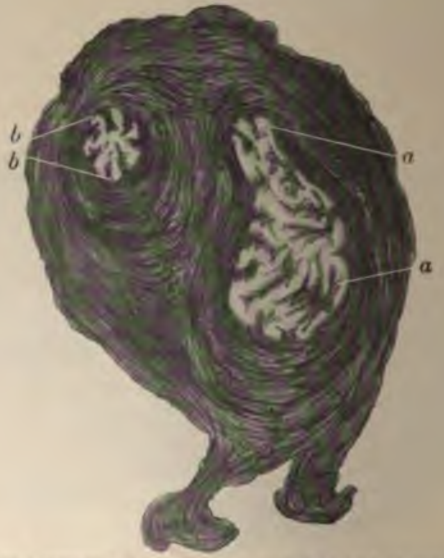


FIG. 239.



Sections made from case represented in Fig. 236 on each side and at extremity of diverti They show distinctly the separate canals and the narrowing of the diverticulum as it app the uterus.

a, a. Lumen of main canal of Fallopian tube. *b, b.* Lumen of diverticulum.

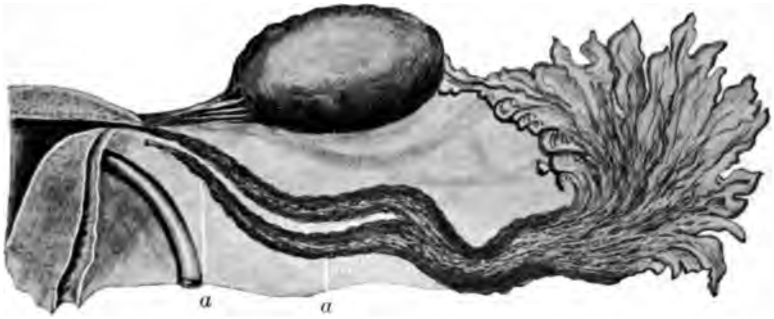
The secondary forms are simply complications of the primary var before described, and are not deserving of separate classification.

various names applied to these forms are in so common use, however, that they can hardly be ignored. They will, therefore, be mentioned later.

Etiology. The point at which the spermatozoa meet and impregnate the human ovum is not definitely known. That the spermatozoa pass through the lumen of the Fallopian tube with ease is a fact, and it is very probable that in man, as in other mammalia in which this observation has actually been made, impregnation occurs in this location.

The habitual ease with which spermatozoa pass from the orifice of the vagina through a virgin os uteri, oftentimes occluded by mucus, into the uterus, and the occasional cases in which, despite frequent disturbance, they travel from outside the vulva, through an almost imperforate hymen, up a vagina containing secretions destructive to their life, and finally pass uninjured into the uterus, make it reasonable to suppose that they may go with not less ease up the uterus into the Fallopian tube, and even into the abdominal cavity. There is no reason to believe that the ciliated epithelium of the tube, which assists the migration of the ovum toward the uterus, obstructs the progress of the spermatozoa, nor is it probable that the peristaltic action of the tube toward the uterus would check the march of so minute a body as a spermatozoon.

FIG. 240.



Left Fallopian tube with diverticulum reconstructed.
a, a. Diverticulum.

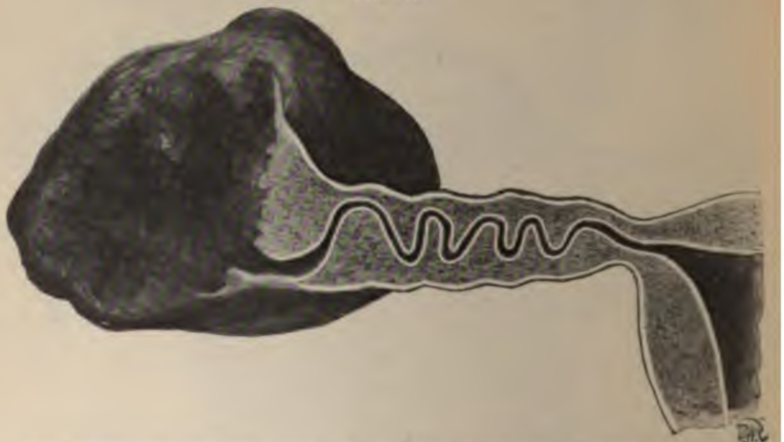
In the lower animals the presence of spermatozoa in the pelvic cavity, as well as in every portion of the genital tract, soon after coitus, has been repeatedly demonstrated. Moreover, the migration of the ovum in the human female has apparently been proved by the occurrence of pregnancy in patients in whom the ovary of one side and the tube of the opposite side had been removed. If this migratory range for both ovum and spermatozoa be admitted, the mechanical theory of ectopic gestation is thereby made reasonably plain. The inference would be, however, that such gestation would be more common, and primary abdominal pregnancy the most frequent form. This, we know, is not a fact, for even the existence of this latter variety can hardly be established.

There is then something characteristic of the tubal mucosa which allows the implantation and growth of a fertilized ovum or some element that inhibits its growth or destroys it in the pelvic cavity. Clarence

Webster explains this by claiming that, beside the mechanical condition which retains the ovum, there is need of "the occurrence of certain necessary reactions in the mucosa, caused by genetic influence and producing decidual changes, such influence existing by reason of a reversion in the tubal mucosa to an earlier type in mammalian evolution."

A pathological condition of the ovum may favor a premature adhesion to the wall of the tube before the uterine cavity is reached. Pathological or abnormal conditions of the tube itself, however, form undoubtedly the most important factor in the causation of ectopic gestation. Chief among these may be mentioned the following: Congenital deviations from normal type, such as exaggerated convolutions (Fig. 241), diverticula (Figs. 236 and 241), and atresias; sagging and attachments by adhesion, resulting in distortion of the tube; pressure from adjoining organs; thickening of tubal walls, either congenital or acquired, diminishing peristalsis; desquamative salpingitis or hyperplasia, destroying the cilia, producing atresia; growths, either in the canal or the walls; obscure conditions, preventing coaptation of the fimbriæ with the ovum or ovary.

FIG. 241.



Infundibular ectopic gestation with Fallopian tube, showing exaggerated convolutions.

Herzog, in a recent article on "The Pathology of Tubal Pregnancy,' concerning this subject, says:

"The etiology of tubal pregnancy is certainly not a uniform one f all cases. It appears to me that in a respectable percentage of cas congenital anomalies of the tubes due to anomalies in early embryoni development of the Müllerian ducts are responsible for the occurrenc of tubal pregnancy. I have previously, conjointly with Dr. F. He rotin, reported cases of tubal pregnancies due to tubal anomalies.

"Another factor which I consider as important in the production tubal gestation is an unduly marked participation of the tubal muco in menstruation. With others I hold that the tubal mucosa takes pa to a certain extent in menstruation. Normally the menstrual chang of the tubal mucosa are insignificant compared with those of the uteri

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[1] Amer. Jour. of Obstet., 1900.

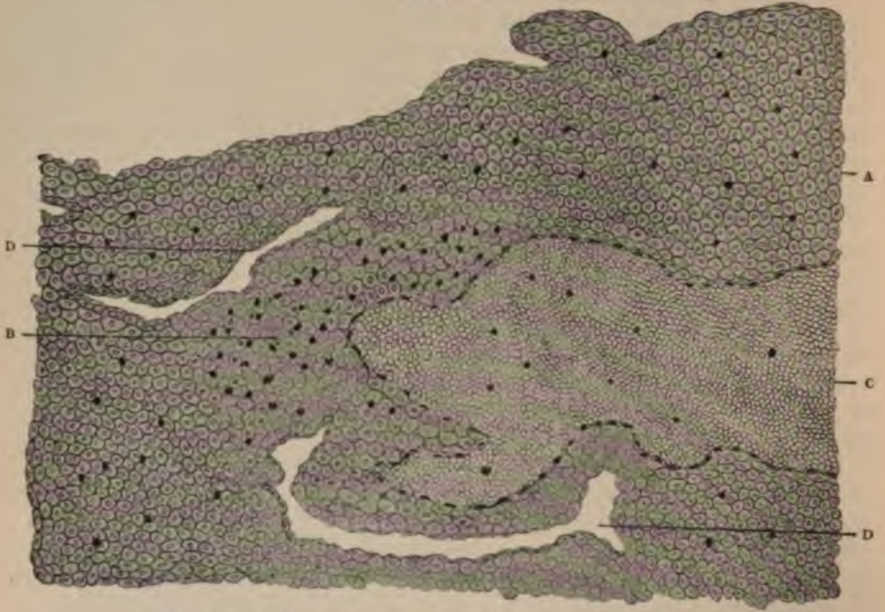
mucosa. Occasionally, however, the tubal mucosa shows intense menstrual changes, which may be so pronounced as to lead to the formation of a hæmatosalpinx. We can hardly doubt that the menstrual changes of the uterine mucosa prepare the latter for the reception of an impregnated ovum, which, as appears most probable from the latest contributions upon the subject, eats or corrodes its way into the substance of the uterine mucosa by the aid of a phagocytic trophoblast. Whenever the tubal mucous membrane undergoes extensive menstrual changes it becomes a soil into which an impregnated ovum can easily implant itself. It appears, therefore, very probable that marked menstrual changes in the tubal mucosa, when they do occur—and they occasionally are present—become the cause of an ectopic implantation of a fertilized ovum. As far as our exact knowledge goes to-day, we must, however, confess that we are unable in most cases of tubal pregnancy to give definitely the exact cause or causes of this event, often so very grave in its consequences."

Pathology. *Changes in the Uterus.* This organ begins to enlarge, both as to its cavity and walls, simultaneously with the establishment of pregnancy in the tube. It continues to enlarge, and up to the fifth month is usually one-third to one-fourth smaller than in an intra-uterine pregnancy of the same age. The enlargement may continue after this time, but at a less rapid rate. Rupture of the tubal pregnancy, when followed by death of the ovum, checks the growth of the uterus, and is soon followed by involution. When, however, death of the ovum does not take place, the uterus may continue to enlarge, though not to the same extent as before the accident. The uterus of an extra-uterine pregnancy at full term usually measures from four to six inches in depth. Involution of the uterus does not commence until the fœtus is dead, and decrease in the size of the uterus is an indication that this has occurred. In general terms, it may be stated that the more remote the place of implantation of the ovum from the uterus, the less the increase in size of that organ.

DECIDUA. One of the most notable changes in the uterus in ectopic gestation is the formation of a decidua. It partakes of the characteristics of the decidua vera of normal pregnancy, and is usually thrown off, either in one complete cast or in the shape of débris, about the time of the primary tubal rupture, and this event is frequently accompanied with metrorrhagia. The casting off of the decidua may precede, accompany, or follow the rupture. The persistence of life in the ovum after primary rupture does not prevent the shedding of this membrane. The decidua aries in thickness from one-eighth to one-quarter of an inch, is rough nd shaggy upon its uterine side and smooth upon its inner surface, and, f course, in the uterus shows no traces of decidua reflexa and decidua rotina (Fig. 242).

ALTERATIONS AND CHANGES IN THE TUBE AND OVUM. These vary eatly with the location of the gestation-sac, but swelling and turgescence e present in all cases from the beginning. This thickening consists at st in simple enlargement of the calibre of vessels due to the stimulus en by the existence of the pregnancy, then of hypertrophy of muslar fibre, the same as the first changes which take place in the uterus normal pregnancy. Then follows the free development of connective tissue and often disappearance of muscular fibres, particularly following the evidences of minute rupture, which disintegrates and breaks them up by small extravasations and hemorrhages, and gives rise to inflammatory and cystic changes ; or pressure-atrophy of the wall takes place opposite the placental attachment, which has become the thickest part of the tube.

FIG. 242.



Scrapings from the uterus in a case of ectopic gestation in the third month.

A. Decidua vera. B. Decidua in the beginning of coagulation necrosis, showing many leucocytes. C. Blood sinus. D, D. Gland spaces. (HERZOG.)

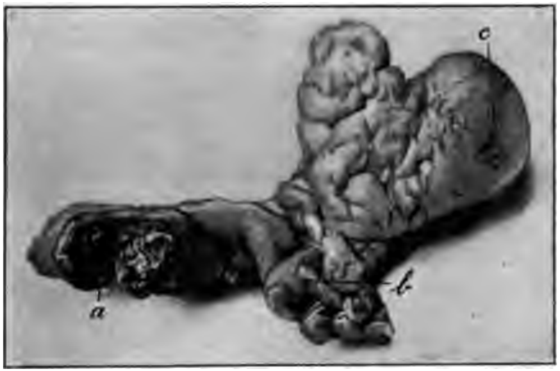
Closure of the ostium abdominale usually takes place about the seventh or eighth week when the oösperm is retained in the middle or inner portion. When, however, it is retained near the abdominal opening, complete closure does not occur, and there is, consequently, a tendency to tubal abortion.

In the apparent exceptions to this rule in which the ostium is not closed at twelve weeks, examination of the specimen and careful analysis of the history usually demonstrate that rupture had taken place several weeks earlier.

It appears that closure of the abdominal opening may also occur much earlier than the seventh or eighth week. The writer has operated on a case of tubal pregnancy in which, as was obvious from the history and from the microscopic examination of the specimen obtained, rupture occurred in the second or third week of gestation. In this case the abdominal opening of the tube was found closed.

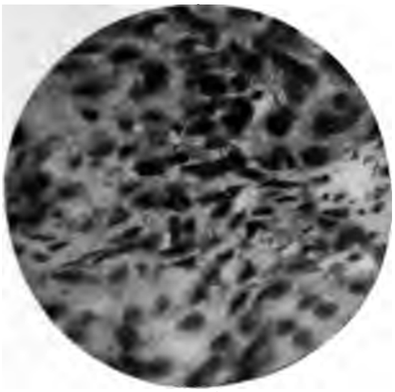
The formation of a decidua in the pregnant tube is now conceded by all competent observers. A number of my own cases have been examined for that purpose, and a decidua has invariably been found (Fig. 246). It has also occasionally been found in the opposite non-pregnant tube. The amount of decidua vera, however, varies considerably in different cases, but in all instances the characteristics of the true decidua of uterine pregnancy are shown; namely, the usual two layers, a superficial compact and a spongy, lower layer. The enlarged vessels common to the whole tube are particularly prominent in that portion of the mucosa covered by decidua to which the ovum becomes attached, and which is known as decidua serotina. This decidua serotina grows more rapidly than the rest of the decidua.

FIG. 243.



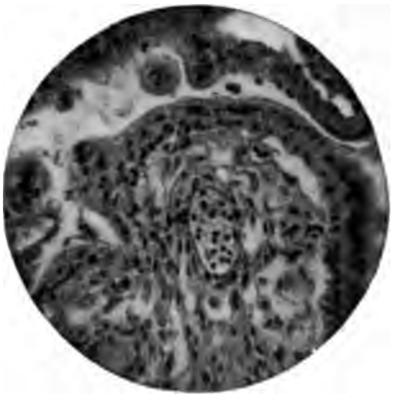
Tubal pregnancy, 2-3 weeks old (natural size).
a. Rupture and blood coagulum. *b.* Closed fimbriated extremity. *c.* Ovary.

FIG. 244.



Decidual cells in serotina; tubal pregnancy, 2-3 weeks old. (HERZOG.)
From case represented in Fig. 243.

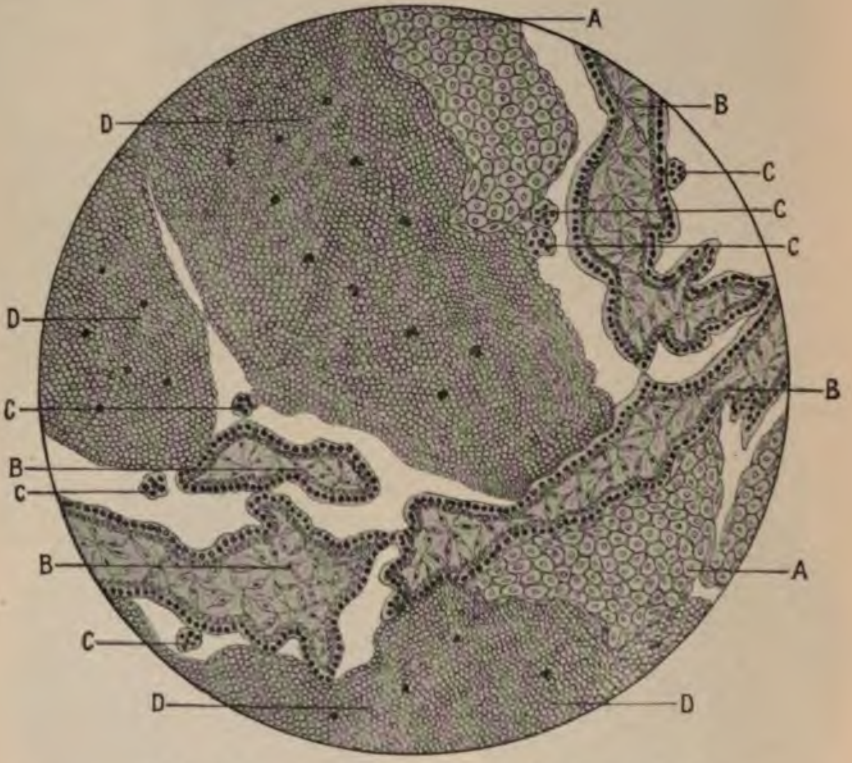
FIG. 245.



Villus highly magnified, showing Langhans layer and syncytium. In the mesodermal core a blood-vessel with nucleated red blood-corpuscles. (HERZOG.)
From case represented in Fig. 243.

At an early period in uterine gestation an intervillous space filled with maternal blood, bounded on the outside throughout most of its extent by the decidua reflexa, surrounds the whole chorion. In tubal pregnancy, therefore, there must also always be formed a decidua reflexa, because an intervillous space capable of retaining the maternal blood can be formed only by a decidua reflexa, unless we assume that the tube very early becomes completely obliterated on both sides of the ovum. Since we have no proof of such a very improbable occurrence, a decidua reflexa becomes an absolute necessity for the establishment of the intervillous space (Herzog).

FIG. 246.



Section from gravid Fallopian tube. Lutz, Obj. 3; Eye-piece No. 3.
A. Decidual cells. B. Villi. C. Syncytial buds cut transversely. D. Blood in intervillous space.

HEMORRHAGES found in the tube are most frequently the result of rupture of the reflexal vessels. As pregnancy advances the decidual cells in the balance of the tube disappear, and inflammatory changes, the result of the minute ruptures, combined with possibly mild pre-existing septic conditions, change the general texture of the mass. The growth of the ovum stretches the lumen of the tube, which gradually becomes, together with the placenta and membranes, a part of the investing heterogeneous gestation-sac.

But little can be said in this connection of the changes in the ovum, its development and attachment being made comparatively plain if the presence of a decidua is admitted, as it thus follows the transformations usual to a pregnancy in the uterus, subject simply to the changes incident to lack of space in the tubes, and the traumatisms which must almost inevitably result, and which will be considered when speaking of the different varieti

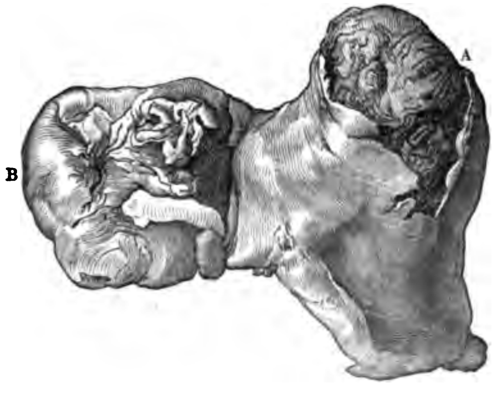
The true investing fœtal membranes, namely, amnion and chorion, differ in no wise from the same structures in uterine pregnancy, but are also subject to the alterations incident to trauma and possible sepsis.

Tubal Mole and Tubal Abortion. The subject of alterations in the ovum can hardly be dismissed without reference to that arrest of development during the first few weeks which results in what is known as a tubal mole. An ovum during its first few weeks of growth, depending as it does for life upon very delicate chorionic villi lightly attached, is in great and constant danger of destruction. In some cases, by reason of chorionic hemorrhage, the circulation is cut off, the ovum is partially or totally detached, remains *in situ* and is absorbed, or, after detachment, particularly when located in the outer third of the tube, it may be expelled through a patent ostium abdominale into the abdominal cavity. This constitutes what is known as a tubal abortion. Sometimes, however, the tube ruptures and the mole is extruded directly into the free cavity, often with most appalling symptoms.

It cannot be stated definitely that subperitoneal rupture does not occur in these early cases, for no observations bearing upon this point have, so far as the writer knows, been absolutely demonstrated. The proof of this condition must depend upon the report of a competent pathologist after thorough dissection.

A TUBAL MOLE resembles a blood-clot in color and consistence, is round or ovoid, and from two to six centimetres in diameter (Fig. 247). It usually presents, on section, a smooth-walled cavity, lined with amnion, occasionally containing fœtal remnants. Both amniotic cavity and fœtal remnants may be absent, but the presence of chorionic villi makes the origin manifest. Bland Sutton believes that a tubal mole "is due to blood extravasated from the circulation of the embryo into the subchorionic chamber."

FIG. 247.



Tubal mole, fifth week.

A. Mole protruding from ruptured portion of tube. B. Ostium abdominale partially closed by infolding of the fimbriæ.

CHANGES IN THE PLACENTA. In no case of tubal pregnancy is there absence of decidual formation, but there is a marked difference in different cases as to the extent to which this membrane is formed. Observations by a number of modern competent observers, looking toward an elucidation of this question, demonstrate the almost constant presence of decidual membrane in the tube. Taking this for granted, the placenta, as in uterine pregnancy, is composed of loosely held masses of chorionic villi with intervillous blood-spaces bounded externally by varying areas of decidua serotina. The development of this organ is necessarily modified by the amount of decidua present. When to this is added the narrowed available space still further constricted by the rugosities of the mucosa and the mobility of the tube, the difficulties in the way of the development and growth of the placenta can readily be appreciated.

When, however, rupture occurs, and the torn walls of the tube spread out, if the ovum survive, the placenta forms further attachments to neighboring structures and continues its growth. The size of placentas varies directly with the vascularity of the structures upon which they become implanted and with the permanence of the attachment. From the beginning the essential elements of disturbance in the development of the placenta are traumatic hemorrhages. The tube wall early in pregnancy cannot, as a rule, accommodate itself to the growing ovum. It becomes stretched, and ruptures take place into the substance of the serotina, accompanied by hemorrhage into the intervillous space, endangering the integrity of villi and chorion.

When an ectopic placenta is examined at any period of gestation, evidences of previous hemorrhages are rarely absent. These hemorrhages are necessarily small while the mass is confined within the tube, but after rupture they may be severe and even fatal. The fatal termination is, however, ordinarily due to what may be termed "detachment hemorrhages"—that is, hemorrhages from maternal vessels consequent upon detachment of the placenta.

Independent of detachment hemorrhages, however, are the constantly recurring extravasations into the serotinal tissue. These intraplacental hemorrhages materially increase the bulk of the placenta, and produce an apparent disproportion between its size and that of the ovum. This disproportion is the foundation for the erroneous statement that the growth of the placenta continues after the death of the ovum. It is very possible that an intraplacental hemorrhage may increase somewhat, but it is hardly reasonable to suppose that the formation of true placental tissue could continue, and this has never been demonstrated. The chorionic villi degenerate and become in a very short time mere phantoms with indistinct outlines. New formation of villi is most improbable. The decidua serotina also undergoes rapid degeneration. Therefore, no real growth of placental tissue can occur after the death of the fœtus; if an increase in size takes place it must be due to traumatic hemorrhages.

The placenta is then transformed from an oval or round disk to a more or less globular mass, which, upon careful examination, is seen to be composed of blood-clots in various degrees of organization, with deteriorated villi interspersed, and a large number of leucocytes, and to contain no more than the normal amount of true placental tissue. In case of very old placentas, indeed, so marked an alteration has occurred that little normal placental tissue can be recognized.

Symptomatology and Diagnosis.

A. Prior to the Fourth Month.

General Considerations. Prior to the fourth month the three cardinal and practically constant points in the diagnosis of beginning extra-uterine pregnancy are (1) disturbance of menstruation, (2) sharp pelvic pain, usually accompanied with faintness, and (3) the presence of a mass adjacent to and connected with the uterus. Certainty of diagnosis is based upon a logical analysis of these three factors.

1. **Disturbance of Menstruation.** Menstruation is almost always retarded; but the variations as regards the amount, character, and periodicity of the hemorrhage are so numerous as to render the description of a typical case difficult. In some cases uterine hemorrhage occurs a day or two following the date of the expected menstruation; in other cases amenorrhœa persists throughout the pregnancy; the flow may continue for two or three days, and may recur with sufficient regularity to simulate menstruation, but this is exceptional. The first day of the flow is seldom or never the twenty-eighth day after the beginning of the last menstruation. Sometimes the flow continues for a day or two, and then recurs at irregular intervals; but in other cases the hemorrhage persists for weeks at a time. The amount of blood lost also varies greatly, from a mere show to a severe hemorrhage. The blood usually contains small patches of mucosa or large, well-defined membranes, and occasionally a complete cast of the lining of the uterus. These hemorrhages, regular or irregular, occurring early in ectopic gestation, usually indicate shedding of the decidua.

2. **Pelvic Pain.** The pain is usually of two kinds: the recurrent, contractile pain due to uterine contractions, and the sharp, tearing pain, accompanied with faintness, which indicates rupture to a greater or less degree. Excruciating pain with syncope usually points to serious rupture.

3. **Presence of a Mass.** When the pregnancy is located in the middle or at the outer end of the normally situated tube, and is unruptured, a well-defined movable mass, contiguous to the uterus, can be felt. When the tube is prolapsed posteriorly, the mass will be felt posterior to the body of the uterus. After rupture into the broad ligament has taken place the mass can still be felt lateral to the uterus, but it is lower, not so well outlined, and less movable. When sepsis has supervened, the presence of exudate may render the outlining of the mass still more difficult. In interstitial pregnancy the mass appears as an irregular bulging at the corner of the uterus. When early rupture into the general peritoneal cavity has occurred, no mass may be felt at all.

The nausea, changes in the breasts, and discoloration of the vaginal mucosa are confirmatory of the diagnosis of pregnancy, and, when combined with the signs detailed above, are strongly presumptive of extra-uterine pregnancy. Valuable corroborative evidence is furnished by the changes in the uterus, and by uterine hemorrhage when it occurs. The adjoining pregnancy stimulates the growth of the uterus, but not to the extent which obtains in uterine gestation of the same age. This disproportion in size becomes more marked as pregnancy progresses. Uterine hemorrhage frequently occurs before the third month of extra-uterine pregnancy, and is usually accompanied with the discharge of decidua, which, as mentioned before, is cast off either in shreds, in large patches, or as a complete cast of the uterine cavity. The absence of chorionic villi after careful search furnishes another link in the chain of evidence. At this stage of the investigation exploration of the cavity of the uterus is warrantable. When, after careful introduction of a sound into the uterine cavity, the uterus is adjudged empty, the diagnosis of early ectopic pregnancy is practically established.

Primary Intraperitoneal Rupture—Hæmatocele. In the great majority of cases, gravid Fallopian tubes rupture prior to the fourth month. This is known as primary rupture, to distinguish it from subsequent ruptures which may occur in the same pregnancy. Primary rupture may be intra- or extraperitoneal. Experience demonstrates that primary intraperitoneal ruptures generally occur prior to the seventh week, and so frequently in the fifth or sixth week after the last menstruation that pregnancy is not suspected. As women with pre-existing pelvic disease are especially prone to extra-uterine pregnancy, menstrual irregularities easily escape attention.

The diagnosis of primary intraperitoneal rupture prior to the seventh week is the diagnosis of intra-abdominal hemorrhage. The absence of marked disturbance of menstruation does not preclude the existence of early rupture. The failure to observe the discharge is not significant, for this may occur simultaneously with the rupture, or may closely follow it. The physical signs are identical with those of intra-abdominal hemorrhage.

The case illustrated by Figs. 243, 244, and 245, though extremely rare and the only one of its kind on record, shows the difficulty of diagnosis when reliance is placed on some retardation of menstruation. In that instance the patient had menstruated regularly for years, and pregnancy occurred, followed by rupture both within four weeks and before the time for the next period to make its appearance.

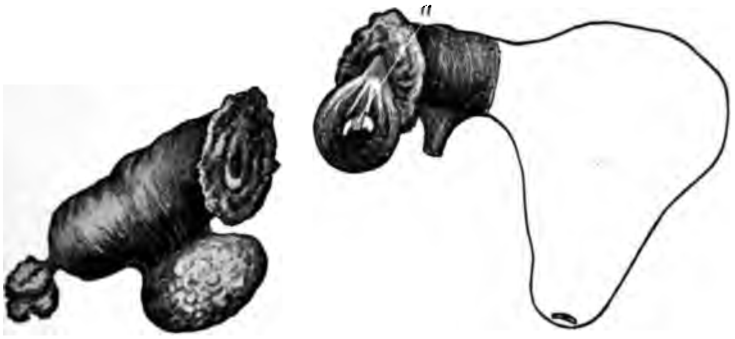
The failure to recognize a tumor near the uterus is not very important. Thorough examination is difficult on account of the condition of the patient. Even when the intra-abdominal hemorrhage is enormous, the chief reliance must be placed upon the general conditions of shock and collapse, as the presence of blood can seldom be demonstrated by fluctuation, abdominal palpation, or bimanual examination. A symptom rarely absent, however, is exquisite general abdominal tenderness. The ovum may be so small as to produce no appreciable enlargement, or it may have been expelled into the general peritoneal cavity.

The following case furnishes an excellent illustration of the symptomatology of primary intraperitoneal rupture.

On September 15, 1894, Mrs. J. P. C. was seized with a severe pain in the abdomen, which she described as feeling "like something breaking in her stomach." Simultaneously there was a gush of bright, pinkish, watery fluid from the vagina, which flooded her thighs and saturated her clothing. She was seen by a physician at 1.30 P.M., and by another an hour later, and at 5.30 by the writer. At that time she was almost *in articulo mortis*, and absolutely pulseless and perfectly cold. The patient was thirty-three years of age, had been married twelve years, and had three children, aged, respectively, ten, five, and three years.

She had never had a miscarriage, and, so far as she knew, had never had uterine disease of any kind. She was a woman of magnificent physical development, weighed 230 pounds, and was full of courage. She had always menstruated regularly; but for several years had flowed for six or seven days at a period. On August 12th, exactly five weeks previous, she menstruated regularly, and the flow continued for six days. On August 29th, without warning, she suddenly had a severe pain resembling a labor pain, which continued for ten minutes, and was accompanied by nausea and vomiting. On August 31st, while travelling on the cars, this pain recurred and lasted half an hour. While away from home she had two or three short, severe pains and a slight diarrhœa.

FIG. 248.



Primary intraperitoneal rupture; fifth week. Tube completely ruptured.
a. Ovum still slightly adherent to its original site.

On September 9th, after her return home, she began to menstruate exactly on time, but the flow was checked by a sudden fright, her son being seized with convulsions in her presence. The same evening she had another short, acute attack of abdominal colic. The menstrual flow returned the next day, but ceased after a few hours. It again returned, but ceased two days before the final attack.

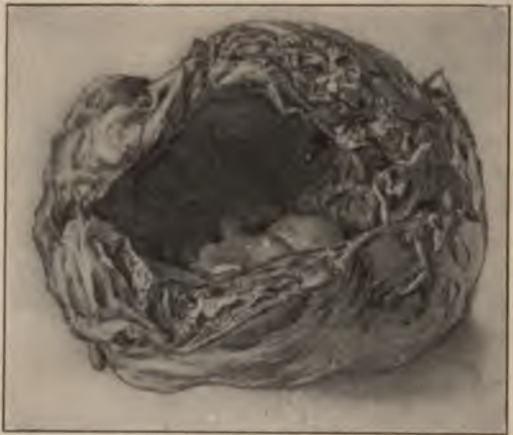
When first seen by the writer it was evident from the profound collapse, indicated by the total absence of radial pulse, and the excessive pallor and death-like coldness of the body, that the patient was suffering from internal hemorrhage; while the dyspnœa made it plain that the time for action was short, and that if something was not immediately done it would be too late. Further physical examination revealed nothing more than local tenderness over the whole abdomen. Sudden pressure would elicit repeated expressions of pain.

A careful and thorough vaginal examination was made, which was entirely negative. The fact that she was flowing at the time, of course directed my attention to the pelvic organs as the probable source of hemorrhage, and the information obtained from the patient's friends and from herself, regarding the previous attacks of pelvic pain, made the diagnosis of ruptured tubal pregnancy more than probable. Two objects were therefore kept in mind in making the examination. First, the determination of the presence of free blood in the abdominal cavity, and, second, the discovery of a mass to one or the other side of the uterus. The examination failed, however, in both respects; repeated percussion over the abdomen absolutely failed to give any impulse or sense of fluctuation, either upon deep digital pressure into Douglas's pouch or at either side of the uterus, and no enlargement of the Fallopian tubes could be detected. The thickness of the abdominal walls in this patient greatly increased the difficulty of and embarrassed the examination.

The correctness of the diagnosis became evident even before the peritoneum was incised. After the incision was made and the intestines pushed back, the blood surged out over the surroundings. A careful estimate of the amount of blood in the abdomen would place it at not less than eighty ounces. The right Fallopian tube was found to be widely ruptured at its middle and the ovum embraced by the gaping edges of the wound (Fig. 247). The lumen of the tube was perfect excepting at the seat of rupture.

The fimbriæ were partially drawn into the abdominal ostium. There was a great attenuation of the tubal wall at the location of the tear, which occurred at a point opposite to the seat of attachment of the ovum.

FIG. 249



Unruptured ampullar pregnancy at the end of the second month (embryo about 2 cm. long. The thinnest part of the gestation sac has been removed after the operation.

Primary Extraperitoneal Rupture—Hæmatoma of the Broad Ligament. An extra-uterine pregnancy, instead of developing in the direction of the free abdominal cavity, may grow downward and cleave the folds of the broad ligament without rupture of the tube proper, the adjoining portions of the broad ligament stretching gradually to accommodate the growing ovum. As a rule, rupture occurs between the seventh and twelfth week of pregnancy.

Here we have, first, the usual signs of extra-uterine pregnancy, together with the constant presence of a mass contiguous to and connected with the uterus. Rupture is indicated by an increase in pain and faintness. The signs before this accident are often not sufficiently marked to denote the character of the pregnancy, and, as a rule, the patient believes herself pregnant in the normal way. Whereas, in the early primary intra-abdominal rupture faintness and syncope are the most striking symptoms, and the pain not so severe, in this variety severe pain is usual, while the collapse is not so extreme. The pain in most cases is recurrent and paroxysmal, coming on without warning and usually soon passing away, to be followed by another series of paroxysms a few hours or a few days later, each attack probably indicating an extension of the rupture. As the blood effused is limited by the resistance of the adjoining structures, we do not witness those appalling symptoms common to the already mentioned intraperitoneal ruptures.

To make the picture plain regarding these cases, if a woman of child-bearing age suddenly complains of severe pelvic pains, accompanied by nausea and faintness; if, on investigation, she says that she has missed one, two, or three menstrual periods, or has flowed in a very irregular manner, and thinks herself pregnant; if she has the usual vulvar and vaginal discolorations common to pregnancy and the changes in the breasts, with nausea, and if these attacks of pain and faintness recur, extra-uterine pregnancy must be strongly suspected. If, on examination, the uterus is found enlarged, but not to a sufficient degree to correspond to a pregnancy of that age, while immediately adjoining the uterus and continuous with it a tense and vaguely fluctuating enlargement is discovered, then ectopic gestation, ruptured extraperitoneally, is a reasonable conclusion, and the case may be so regarded and treated. The signs mentioned may not all be present, and many cases are sufficiently obscure to bring doubt, but to the experienced surgeon there are usually landmarks enough to outline the course to pursue.

Early cases of this kind undoubtedly occur which are not diagnosed, the ovum and secundines being gradually absorbed and the patient never being very ill; but when the accident takes place after the seventh week severe illness generally ensues. Even at ten and twelve weeks the rupture may have proceeded so evenly and slowly that the patient may not seek medical advice until constitutional symptoms indicative of sepsis appear.

In the very great majority of cases the ovum dies at the time of the rupture, and no further growth occurs. The traumatism existing, however, leads to the formation of protective exudate, which very materially increases the size of the whole mass. This increase in size gives rise to more pronounced pain, and sooner or later, in almost all cases, sepsis supervenes and the mass breaks down into a suppurative focus, while the patient develops fever, sweats, chills, and the usual constitutional evidences of retained septic material.

In patients seen for the first time in this condition, the diagnosis is often difficult, and in some, where the history is not very typical, is even impossible, as the signs differ little from those of the common forms of septic pelvic invasion. Careful inquiry into the history is the best reliance for avoiding mistakes.

Secondary Ruptures. This term applies only to the last-named variety, namely, the extraperitoneal variety, where the ovum, after forcing its way below the peritoneum in the folds of the broad ligament, ruptures into the general peritoneal cavity. These secondary ruptures may occur from different causes. After the primary rupture the ovum may survive, and its continued growth almost invariably results in communication with the general cavity. This variety of secondary rupture is sometimes sudden, and the effusion of blood into the general cavity may be so extensive as to give rise to the most serious symptoms with fatal results. The appearances are very similar to those of primary rupture of early date, and the treatment must be equally prompt. A secondary rupture may follow a primary rupture so closely that they can hardly be differentiated.

In other cases, however, *the ovum surviving*, the secondary rupture may be slow and not extensive, the opening reinforced by quickly formed exudate and the symptoms more subdued. Such accidents may occur time and time again, and, if the ovum is not destroyed, there develops that class of so-called advanced, abdominal, extra-uterine pregnancy which will hereafter be described.

When the *ovum is destroyed* by the *primary rupture*, secondary ruptures may still occur. If the first rupture has so separated the ligamentous folds that only a thin peritoneal membrane is interposed between the mass and the general cavity, blood-pressure alone from recurrent hemorrhages may complete the rupture; or, the whole mass including its peritoneal covering becoming macerated and softened by sepsis, secondary rupture may result from lack of consistency.

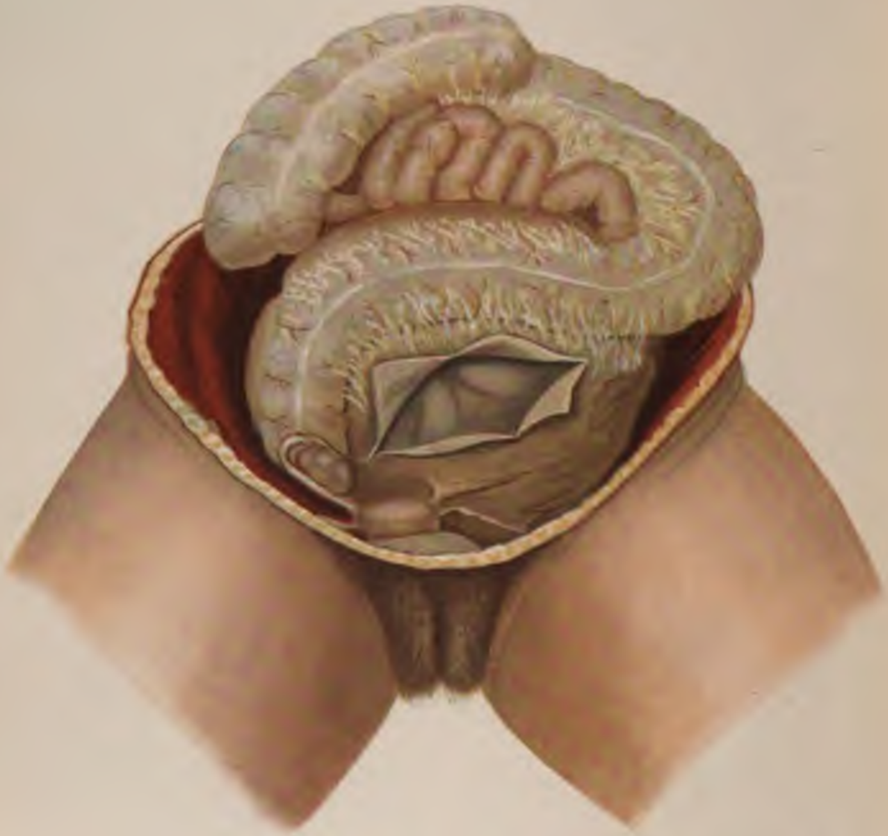
The interstitial or tubo-uterine and infundibular or tubo-ovarian varieties of ectopic gestation are especially prone to early primary intraperitoneal rupture. In the true tubal variety, if the placenta is implanted on the superior inner surface of the tube, extraperitoneal rupture is more likely to occur; if, on the contrary, it is implanted on the lower inner surface, the upper part of the tube thins out, and early rupture into the general peritoneal cavity is most probable. Almost all the extraperitoneal ruptured cases belong to the true tubal variety.

B. After the Fourth Month.

Unruptured Tubal Pregnancy. When the ovum survives all the dangers which threaten its existence, new signs become evident after the fourth month which demand separate consideration in their relation to diagnosis. Few ectopic gestations survive the fourth month, and very few, indeed, of these have not been subject to more or less rupture, either intra- or extraperitoneal. Most of the reports of examinations of extra-uterine cases are not sufficiently minute and explicit to base a positive opinion upon; but, nevertheless, there can be no doubt that women have passed through extra-uterine pregnancy to term, carrying the child within the enlarged dilated tube, without appreciable rupture in any direction. Many of the reported cases of this variety have, however, been shown to have previously ruptured slowly below, between the folds of the broad ligament.

Abdominal Pregnancies Without Rupture. The space at command will not admit of reviewing the discussion whether such a condition can exist. Suffice it to say that advocates of that theory believe that an impregnated ovum can find its way into the general cavity or that an ovule can there become impregnated and implanted, and grow even to full term without rupture. Their opponents stoutly maintain that all so-called abdominal pregnancies were originally tubal, that rupture took place into the general abdominal cavity, but that sufficient attachment to the tubal mucous membrane remained to nourish the ovum, and that eventually, although the placenta became universally attached to sur-

PLATE XXX.



Left Tubal Pregnancy operated on five months after signs of life had disappeared. The superior surface of the left tube is still visible on the surface of the sac. The left ovary was visible only as a bluish flattened patch apparently forming a part of the sac wall. The sac developed between the folds of the mesosalpinx and mesosigmoid. The patient was suffering from uterine hemorrhage, but had never been seriously ill. There had never been signs of rupture, and the whole sac was dissected intact into the cornua of the uterus.

rounding structures, all cases that were examined with sufficient care by competent authorities could always be traced to the tube as the original site of primary implantation. The consensus of opinion at this date inclines to the latter view. (See Plate XXX.)

In almost all cases of advanced ectopic gestation we have the symptoms and signs common to uterine and ectopic gestation, namely:

Disturbance of menstruation;
Changes in the breasts;
Enlargement of the uterus;
Nausea;
Changes of the vulva;
Thinning out and softening of the lower uterine segment;
Mucous vaginal discharges;

as well as the symptoms heretofore described as resulting from rupture of greater or less extent in the earlier months.

As the gestation advances beyond the fourth month the other signs which become manifest demand special consideration. Of these the principal are: (1) changes in the breasts characteristic of advanced pregnancy; (2) movements of the fœtus; and (3) abdominal enlargement; while careful examination often reveals (4) ballottement; and (5) placental souffle.

1. **Changes in the Breasts.** These are practically similar to the changes which occur in uterine pregnancy, but are generally not so well marked; the areola is not so well defined, the breast not so full, nor the secretion so abundant.

2. **Movements of the Fœtus.** The perceptibility of these movements differs according to the variety of the case. When dealing with a case of so-called abdominal pregnancy, the result of secondary rupture into the free peritoneal cavity, if the patient is reasonably thin, the movements are often extremely plain to the examiner, even when hardly noticeable to the patient. When near term and the child is reasonably vigorous, the movements may be felt and seen so plainly immediately beneath the abdominal wall as to form a valuable diagnostic sign. In the subperitoneal forms the movements are not so plain, but may be very painful to the patient, although they closely resemble those of the fœtus in utero. Generally speaking, if the pregnancy advances to the fifth month, the movements of the fœtus are thereafter more plainly discernible than are those of a uterine pregnancy of the same age.

3. **Abdominal Enlargement.** Proper and painstaking observation of the abdominal enlargement of a woman supposed to be with child extra-uterum is a matter of the very greatest importance. While the ovum is small and the mass containing it is buried in the pelvis, the abdomen is, of course, not enlarged. When the enlargement becomes discernible, it differs according to the variety of the case. In general, it may be said that it differs materially from normal gestation in that it is not so symmetrical nor is it, at first, so centrally situated. If the patient is the victim of an interstitial pregnancy it may show very soon after the third month, usually slightly to one side. If the gestation is free tubal and subperitoneal the enlargement will usually show first on the side affected, generally resonant from superimposed intestines and more or less irregular and nodular; while if abdominal it will be still more irregular and

nodular, the mass plainly recognizable, and unless adhesions have formed to the intestine it will be dull on percussion. The mass is often wider from side to side and differs essentially from the smooth ovoid of the normally pregnant uterus.

Bimanual examination, rectal and vaginal, of a six to seven months' ectopic gestation will for the experienced examiner throw much light upon the nature of the case. The uterus at this stage can usually be outlined, and a well-marked groove between the uterus and sac can often be made out. Great care must be taken, however, in reaching a definite conclusion: A pregnant retroflexed uterus in some cases is most deceptive, while an advanced unruptured true tubal or interstitial pregnancy may be so intimately blended with the uterus as to make the outlining of that organ well-nigh impossible. In true tubal unruptured pregnancy and in the ruptured subperitoneal variety a sign of importance is the obliteration of the vaginal fornix on the affected side. (See Plate XXXI.)

In cases where there have been repeated ruptures with hemorrhages surrounded by exudate, the diagnosis is sometimes very difficult, the abdomen and pelvis being filled with irregular masses varying in size from small nodules to lumps the size of a fist, and the whole matted together by adhesions. The uterus is adherent to these masses, fused among them, and often indistinguishable from them.

The fœtus itself may be palpated sometimes with the very greatest ease, and the extreme thinness of the tissues between the overlying hand and the fœtus is often quite a characteristic sign. Palpation of both fœtus and uterus is frequently rendered difficult, however, by the implantation of the placenta upon the anterior wall of the sac.

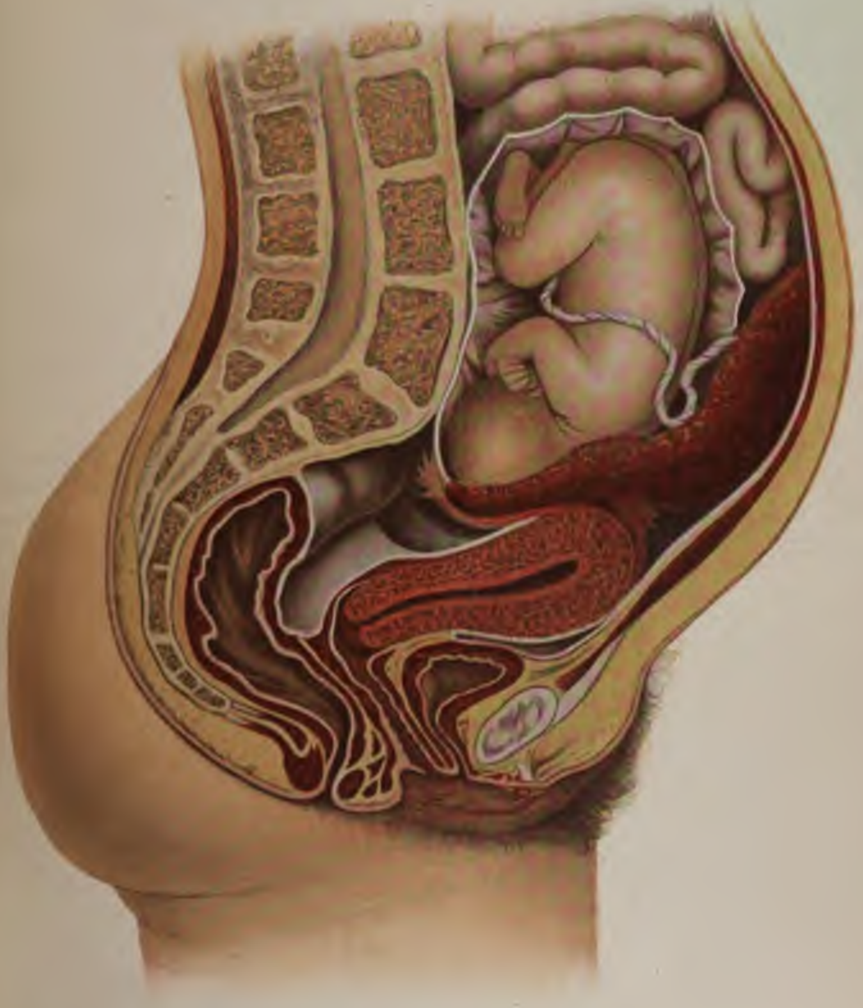
If the sac is interstitial it may still retain its central location, but its length will be out of proportion to its breadth. If tubal, the uterus will usually be pushed to one side, and almost always be crowded up behind the pubes, as in the majority of cases the sac settles down in Douglas' pouch. If the pregnancy develops very low down, and if adhesions do not form, the uterus may be so crowded up that the cervix can hardly be reached. The size of the organ does not correspond to the age of the suspected pregnancy, varying, when the case is at term, from four to six inches in depth. In some women examined at this time, the nature of the case is most apparent, the important item of diagnosis being the outlining of the uterus proper and the determination of its location as independent of the sac.

4. **Ballottement** may be elicited either anteriorly or posteriorly to the uterus.

5. **Placental Souffle.** This sign, common to normal as well as to extra-uterine pregnancy, is of significance only in a small proportion of cases. It begins to be heard about the end of the third month, but is often very faint. In secondary abdominal ruptures, when the placenta spreads out anteriorly just beneath the abdominal wall, it may prove a valuable sign, as it is then extremely loud, is sometimes spread over almost the entire abdomen, and by its intensity, suggests the character of the case.

General Conclusions Concerning Signs and Diagnosis. From a perusal of the foregoing remarks on the signs of ectopic gestation it becomes evident that the existing variations are misleading by reason of their great

PLATE XXXI.



Secondary Abdominal Pregnancy at Eight Months, Primarily Tubal. The primary attachment of the placenta is plainly discernible at the original tubal site. After rupture the placenta grew and became attached to a large surface on the anterior abdominal wall. The child was delivered through a retro-uterine vaginal incision.

diversity, and yet the diagnosis, after a time has elapsed, is not usually attended with as much difficulty as might be inferred.

Diagnosis is well-nigh impossible in patients who come under observation early in pregnancy and before any degree of rupture has occurred. There are then present evidences of pregnancy and a mass adjacent to and, moreover, connected with the uterus. If such a patient has been carefully examined within four or five months, or just before the beginning of the ectopic gestation, and no mass found, the recent appearance of the latter becomes extremely significant. If no such opportunity has been offered, however, there is often little, if anything, to differentiate between the gestation sac and a possible cystic enlarged ovary, a dermoid cyst, or any condition characterized by such an enlargement and not inconsistent with pregnancy.

One can seldom be certain in this class of cases. Beside the signs of pregnancy and the presence of the enlargement alluded to, it can only be mentioned as an aid in diagnosis that there is usually more pain, which the patient describes as griping or colicky, coming on sharply and leaving suddenly, to be soon repeated, usually lasting from a few hours to a day or two, and followed, it may be, by a respite for a few days, when another series of pains occurs. The lump felt near the uterus may also be said to be rather soft and possibly slightly fluctuating; it is generally unattached and movable and throbbing because of enlarged vessels.

If hemorrhage occurs from the uterus, however, very great assistance is derived from a microscopical examination of the discharge, as by this is often revealed the presence of decidual cells and the absence of chorionic villi.

When primary rupture into the abdomen occurs very early, say from the fourth to the eighth week, the hemorrhage in the abdominal cavity is usually large, and these cases present a most striking and almost unmistakable picture.

Subperitoneal ruptures take place from the seventh to the twelfth week of pregnancy. Before rupture the paroxysms of pain are more frequent and the pains more severe, and the shock resulting from the rupture is not so great. Examination at this time reveals a large semi-fluctuating mass filling one side of the pelvis, more or less obliterating the vaginal sulcus on that side, with a broad base and so intimately blended with the uterus as to make the outlining of the latter difficult.

In secondary ruptures in the peritoneal cavity we find the symptoms just described under subperitoneal rupture, followed by those which belong to primary ruptures.

The symptoms of advanced ectopic gestation are the symptoms of advanced pregnancy with infinitely more general abdominal disturbance than is usually found in uterine pregnancy of the same age. These disturbances are due not only to the conditions already described, but to innumerable, accidental, coexisting complications.

In the subperitoneal variety displacement of contiguous organs must necessarily occur. The bladder, uterus, rectum, ureters, and kidneys are always more or less displaced or compressed, with resultant disturbance of function. Hence we frequently observe dysuria, indigestion, and constipation, even to the point of obstruction, or it may be hydronephrosis or nephritis, with or without eclampsia, and excessive œdema from compression of the vessels.

Peritonitis, which is a constant complication, is especially severe in the abdominal variety. Whereas, fatal general peritonitis is sometimes set up by the rupture of an early tubal pregnancy, in advanced pregnancy it usually assumes a more chronic type, producing great alteration in the sac-wall and universal adhesions, so much so that the relations of the various structures are recognized with difficulty.

Hemorrhage is also very common, not the excessive hemorrhage into the peritoneal cavity which occurs in early pregnancy, but repeated, small hemorrhages circumscribed by surrounding adhesions.

Pain is the dominant symptom in the vast majority of cases of advanced ectopic gestation with or without rupture. A few cases have, however, been observed in which a child has been carried to term extra-uterum without excessive pain. These were probably cases of unruptured true tubal pregnancy, and are extremely rare. Pain is the natural result of the visceral displacement, of the repeated hemorrhages, of the pressure upon nerves, and of the peritonitis. The pain which many women suffer in the later months of ectopic gestation is agonizing.

False or Spurious Labor. When the fœtus has reached term, spurious or false labor supervenes. It may, however, occur earlier, at the seventh or eighth month. This peculiar phenomenon has attracted much attention and given rise to many conjectures, but no very satisfactory explanation of its occurrence has been advanced. It differs materially in different patients, being sometimes abrupt, well marked, and consisting of defined contractile pains, gradually increasing in severity and lasting from a few hours to one or two days, and after reaching a certain degree of intensity gradually subsiding, it may be, never to return. In other patients it recurs a number of times several days apart, so that a woman may have had a number of so-called spurious labors. There is really but one true labor, and that follows or rather causes the death of the child. Pains recurring later are probably due to inflammatory changes in the gestation sac or to some complication. In some patients the movements of the fœtus become gradually fainter, and the signs of active living pregnancy subside without the occurrence of false labor.

Often during such labor the movements of the child become excessively active; when the climax of pain is reached all movements suddenly cease and the pains gradually subside.

Accompanying these labor pains there is usually hemorrhage from the uterus, sometimes very slight, at other times very profuse, and if decidual membrane remains it is generally expelled. Are these pains caused by contractions in the uterus or in the gestation-sac? The changes that take place in the uterus, the expulsion of membrane in some cases the almost constant occurrence of hemorrhage, indicate that in all cases the uterus contracts, but it seems almost impossible for notable contraction to occur in the wall of a gestation-sac, often hardly thicker than parchment, and which possesses almost no muscular tissue. Probably contractions in the sac proper occur only in the subperitoneal, true tubal and interstitial varieties, where the sac wall still contains a good deal of muscular tissue.

Changes After Spurious Labor. Well-defined spurious labor always results in death of the fœtus; following this there is subsidence of the abdominal swelling, and involution of the uterus, accompanied by moderate lochial discharge resembling that of uterine pregnancy, but not so profuse. The placental souffle gradually disappears, being seldom noticeable after two or three weeks. The breasts may discharge milk for a few days. Well-marked and immediate decrease in the size of the abdomen is not always constant, sometimes because of delay in absorption of the liquor amnii or because of increase in the placental bulk caused by hemorrhage from vessels ruptured during the spurious labor or disintegrated by septic changes.

Sometimes following spurious labor septic symptoms appear, hectic fever develops, and the whole gestation-sac breaks down into a suppurative gangrenous mass. The pus burrows in various directions, almost always finding its way into some adjoining organ or through the abdominal wall, whence it is expelled, the disintegrated remains of the fœtus following the same channel. Numerous cases of gradual expulsion of the different parts of fœtuses by way of the bladder, rectum, vagina, or abdominal wall are recorded in the literature. Very few, if any, advanced cases are mentioned as opening into the general peritoneal cavity and proving fatal by rapid septic peritonitis, because when the gestation-sac reaches certain dimensions the pressure and inflammatory changes obliterate the general cavity and all the neighboring organs become intimately adherent to the outer surface of the sac so that there is no free cavity for the pus to break into. This process of maceration, suppuration, and expulsion, however, is usually fraught with infinite pain and imminent danger to the unfortunate victims, many of whom die exhausted by hectic fever.

In a reasonable proportion of these cases the fœtus and its investing membranes and placenta undergo peculiar and interesting changes without septic symptoms, these changes resulting in the abdominal inclusion of the modified fœtus, now styled *lithopedion*. This term is supposed to apply only to calcified fœtuses, but is generally used to signify a fœtus retained for a long time without putrefaction and suppuration.

The changes may result in mummification, or calcification, or adipocere formation of the ovum, or the sac, or both, the same specimen frequently showing the various formations in different locations.

MUMMIFICATION seems to result from absorption of all the fluid portions of the fœtus, and it may be of the sac and placenta, the hard bones remaining more or less intact, and the soft parts having the appearance of dark-brown, shrunken parchment.

CALCIFICATION means hardening of all the parts from impregnation with lime salts.

ADIPOCERE formation refers to that condition in which the soft parts of the fœtus and even portions of the bone are converted into a soft soapy mass, supposed to be due to a combination of the fats and ammonia.

A fœtal sac which has undergone these changes may remain *in situ* for an indefinite number of years. It is reported that many of them have been carried without harm for thirty, forty, and even fifty years, being then demonstrated post mortem. At any time, however, even after many years, without apparent cause, infection of the sac may occur, attended with all the dangers described as resulting from primary septic infection, such as happens immediately after spurious labor.

Treatment.

1. Prior to the Fourth Month.

General Considerations. Surgery offers the only treatment of value in ectopic gestation prior to the fourth month. In exceptional cases operation is not advisable:

When the patient is moribund, operation is useless.

When the patient is recovering, watchful expectancy may be all that is necessary. A blighted ovum can unquestionably be absorbed. The patient may not come under observation until recovery is well under way. If a mass, the character of which is undoubted, is painless on palpation, is known to be decreasing in size, and is becoming firmer in consistency, and if the patient presents no symptoms, under such circumstances operation would be meddlesome interference.

When the diagnosis is obscure. The ovum may be expelled through a patent ostium abdominale into the general peritoneal cavity, and be there absorbed, or it may perish and be absorbed *in situ,* or intra- or subperitoneal rupture may take place and the symptoms not be sufficiently marked or severe to establish a diagnosis or to demand exploratory incision.

Morphine injections into the gestation-sac or the passing of a strong electric current through it, with or without puncture, are measures which were much in vogue in former years, the rationale of such measures being the destruction of the life of the fœtus, trusting to nature to absorb the products of conception. Experience has proved beyond doubt the inferiority of these methods of treatment. It is often impossible to determine whether the fœtus is alive or dead, and its death, in the majority of instances, is not followed by absorption with cure of the patient. The employment of these measures does not make the diagnosis clear when there is doubt, and, beyond all, the manipulation and interference incident to their thorough application have proved at least as dangerous as operation.

In no department of surgery have the results been more brilliant, more perfect, and more life-saving than in the modern surgery of early ectopic gestation.

(*a*) Before Rupture.

Unless one of the above-noted exceptional conditions exists, unrupture ectopic pregnancy prior to the fourth month should always be remove This is usually best accomplished by median abdominal section wi removal of the affected tube and its contents. The operation is e tremely simple, as adhesions are not usually present. A ligature is pla on either side of the mass, and the latter excised completely, bleedi points being caught and, if necessary, ligated. The cut surfaces a brought together by means of catgut sutures, thereby maintaining t function of the broad ligament in supporting the uterus in position, a another overhand continued suture, to cover traumatism and sutures wi peritoneum, thereby preventing adhesions, adds to the safety of the patient. Although we usually employ catgut, the objections to silk are not of importance, for no septic focus is encountered, and if the operation be properly performed, without the introduction of sepsis, the convalescence will be rapid and without complications.

When the pregnancy is of the interstitial variety an incision is made through the muscular layers down to the sac, which is then shelled out carefully, the bleeding being checked by one or two layers of buried sutures, care being taken to cover the seat of operation with peritoneum by fine superficial sutures. In these cases it is particularly important not to close the abdominal cavity until all oozing has ceased.

(*b*) AFTER RUPTURE.

1. Primary Intraperitoneal Rupture. In speaking of the symptomatology of this phase of ectopic gestation the statement was made that "The diagnosis of intraperitoneal rupture is the diagnosis of intra-abdominal hemorrhage, and the physical signs are identical." It may now be added that the treatment is that of intra-abdominal hemorrhage. The responsibility in some of these cases is immense; but the operator must not hesitate. Such patients frequently die in a few hours. The abdomen must be opened and the bleeding point ligated. The symptoms are usually very acute and the hemorrhage most abundant. After the diagnosis is established, the operation should be performed even if the patient has rallied, for the next hour may witness a new and, this time, fatal hemorrhage. Such patients are never safe, for they bleed repeatedly, and there is a gratifying uniformity of success following all these operations when the patient is not moribund.

Acute Early Primary Ruptures with Free Abdominal Hemorrhage Should Always be Operated by the Abdominal Route. A woman suddenly faints, immediately receives competent medical assistance, but notwithstanding all treatment, in an hour or two is in profound collapse with the clinical signs of early primary rupture of ectopic gestation. This is a typical fulminant case, and the patient is bleeding to death. Abdominal section should forthwith be made and direct ligation applied. Fill the bowel with normal salt solution; place the patient in the Trendelenburg position, on the bed, if need be; thoroughly cleanse the field of operation; open quickly; dip the hand at once through the blood down to the point of rupture; place a clamp on each side of the rent; wipe away sufficient blood to enable ligatures to be passed; sweep the open hand a few times around the abdomen and remove the large clots and possibly the product of conception; exsect the tube; make sure of the hæmostasis and immediately close. The hemorrhage from the bleeding point can often be controlled in four or five minutes, and the operation completed in fifteen. During all this time, if necessary, continuous infusion of physiological saline solution into the cellular tissue is being made by an assistant.

If during the operation septic material is encountered in the abdominal cavity, be it exudate around the affected tube or disease of the other tube, or doubtful conditions in the region of the appendix, or if the operator is not reasonably certain of the aseptic character of his manipulations, then, if the patient's condition permit, the abdominal cavity should be thoroughly cleansed, after which drainage would better be employed through the lower end of the wound or through the vagina. If, however, the patient's strength will not allow such prolongation of the operation, time may be saved by the introduction of a large Mikulicz drain.

In arriving at a proper conclusion whether or not in a case of this variety the patient will still be able to bear operation, a symptom of considerable importance is the presence of great restlessness, as it frequently means impending death, and, therefore, might directly contraindicate interference. No matter how profound the shock, a patient is very seldom beyond hope of safety by rapid operation if she does not exhibit this restlessness.

Discrimination should be employed, if possible, in differentiating between recurrent temporary swoons and profound progressive collapse, and it should be remembered that the shorter the time between the beginning of the attack and profound collapse the more urgent the need of immediate operation.

Blood is left free in the abdominal cavity when the conditions of asepsis are supposedly maintained, because the shorter the operation the better the prospective recovery; the less the manipulations, the less the absorptive powers of the peritoneum are impaired, and because the absorption into the circulation of the serum left in the cavity begins at once and stimulates the patient pending the general revival of vital forces.

The Trendelenburg position is advised because the presence of large quantities of blood in the pelvis frequently interferes materially with the proper application of ligatures; because inversion of the patient causes gravitation of much of this blood toward the diaphragmatic region, where it is more easily absorbed, and because this position lessens the syncope.

In the primary intraperitoneal rupture of interstitial pregnancy the treatment is exactly the same as that just described, for the symptoms are, if possible, more acute, except that it is not always necessary to exsect the tube, as the cavity which is left after complete removal of the ovum is closed by successive layers of sutures. If the gestation has materially advanced before rupture occurs, the traumatism inflicted upon the uterus may be so serious as to necessitate hysterectomy.

2. Subperitoneal Ruptures. Subject to the exceptions noted under the head of general considerations, removal of the offending gestation-sac is the proper treatment for the cure of patients affected with subperitoneal rupture. As the hemorrhage in these cases, however, is restricted by the surrounding structures, the symptoms are less acute and alarming, and the shock not so great, although the pain is often much more severe.

Although there is no doubt that many of these cases would recover b the unaided efforts of nature without operation, the latter is much to b preferred when the patient is seen soon after the rupture, because it eliminates many possible dangers, usually saves the patient much pain, a in the great majority of instances, results in recovery with complete a perfect physiological functions. When the patient does not come und observation until a considerable time has elapsed since the rupture, eith she is convalescent or is suffering from complications, the treatment which will presently be described.

Acute non-septic subperitoneal rupture should always be treated b median abdominal section. Especial care should be taken in opening the abdominal cavity when, as frequently happens, the rupture does not occur until the tenth to the fourteenth week, for adhesions may be present and the contents of the sac be septic. The Trendelenburg position materially facilitates the operation. After the abdomen is opened the first step, and one of great importance, is carefully to wall off the affected area with pads of aseptic gauze so as thoroughly to protect the healthy portion of the cavity and its contents. If fluctuation is evident in a portion of the mass, a very small incision is made to open this part first, or a trocar may be introduced, and the liquid contents caused to flow out slowly, being caught on large gauze sponges. The whole mass is then shelled out of its bed and the vessels ligated. In some easily accessible cases the vessels may be ligated first. Occasionally the hemorrhage is very free, and a Mikulicz pelvic tamponade becomes advisable.

3. **Secondary Ruptures.** The treatment of secondary ruptures is similar to that of the primary intraperitoneal form. The most important item to be kept in mind is the liability of the contents of the sac to be septic; therefore, the patient should not be placed in the Trendelenburg position until the abdomen is opened, the parts, if possible, well isolated, and the peritoneal cavity cleansed to the extent that the condition of the patient will allow.

SEPTIC CASES AND THE VAGINAL INCISION. When a patient has passed safely through the first stage of rupture without operation, she may, and very frequently does, suffer from various complications, all of which are the results of sepsis. The woman with primary or secondary intraperitoneal rupture may die in a few days from general diffuse peritonitis. As soon as such a condition is recognized an abdominal incision should be made, the cavity carefully mopped out or irrigated with warm normal salt solution, if it seems impossible to cleanse it properly with gauze, after which a large drain may be left protruding through the lower angle of the abdominal wound, or through an opening made into the posterior vaginal cul-de-sac, or both. These extremely dangerous cases are, fortunately, rare.

Generally the sepsis is local, involving at first only the gestation-sac and the affected tube and the blood-clots resulting from the hemorrhage at the time of rupture. Exudate protects the general peritoneal cavity. If suppuration follows, adjoining organs may become involved, and pelvic abscess, with all its possible destructive lesions, result. With a milder form of sepsis suppuration may not occur, but fibrino-plastic exudate may eventually bind together all the affected parts and the adjoining organs in a conglomerate mass, giving rise to innumerable functional disturbances.

In all these septic cases, if the mass is situated well down in the pelvis, vaginal incision with drainage is frequently the most desirable operation and is followed by the happiest results. The danger of hemorrhage usually disappears when septic conditions become manifest, because the vessels are occluded or much lessened in calibre.

A wide incision is made through the posterior vaginal fornix, the mass thoroughly penetrated and broken up, and most of the débris removed. Abscess cavities are opened and drained, and adhesions thoroughly separated. Drainage, preferably with gauze, completes the operation.

If such an operation is skilfully performed it is safer and shorter than by way of the abdomen, avoids the abdominal wound with its scar and tendency to hernia, and seldom fails to cure the patient. A suppurating hæmatocele or a phlegmon of the broad ligament resulting from a very early rupture may consist simply of a single cavity. Drainage may be established through a small opening posterior to the uterus, and, although the procedure is so slight as scarcely to deserve the title of operation, the result may be ideal.

The precautions essential to success in these vaginal incisions may be mentioned briefly as follows:

1. Make sure that the incision is sufficiently large to permit thorough drainage.

2. Make certain that no septic focus remains unexplored. A proper knowledge of the anatomy of the parts involved and reasonable tactile sense will enable the operator to avoid injury to important structures. In most instances it is less dangerous to open the free cavity and disengage all the adhesions possible, than to leave inflammatory masses untouched. Pay especial attention to the condition of the ovary on the supposed unaffected side.

3. Remove all blood and cleanse accessible soiled areas, but do not irrigate.

4. Do not use tubular drains, but drain the various infected regions with long narrow strips of gauze, drawn out like rope the size of a lead-pencil, bunching them together, and sufficient in number at the lower end to form a large drain, which will keep the vaginal opening stretched wide, and produce pressure on the vaginal and cellular vessels behind the cervix. The many bunched-up, small, rope-like strips of gauze are much less painful to remove than the larger gauze drains ordinarily employed.

5. Interfere with the patient as little as possible after the operation. If symptoms do not demand a change, allow the first drain or packing to remain in place for six or eight days; then remove it carefully and replace it by four or five small pieces, making a drain the size of a large forefinger, which should be allowed to remain in place for four or five days. Remove and replace once more, and in from fifteen to eighteen days remove the last drain and give vaginal douches. There will be a discharge for some time, but in three weeks fourteen out of fifteen of these patients will be practically cured.

Beware of treating a recent intraperitoneal or subperitoneal rupture by vaginal incision and drainage before sufficient time has elapsed to make it reasonably certain that the vessels are occluded, for in some such cases you will witness the most furious hemorrhage from a remote point which cannot be reached through a vaginal incision. In case of doubt it is best to operate through a suprapubic incision.

2. AFTER THE FOURTH MONTH.

General Considerations. When an ectopic gestation has advanced well into and beyond the fifth month there are various considerations of importance bearing directly upon the safety of the mother which demand recognition and call for the greatest exercise of judgment on the part of the surgeon. The development of the sac, the increase in the size of the bloodvessels, the development of the placenta, and the probable presence of adhesions, all combine to increase the danger of interference very materially. As the gestation advances the whole mass does not present itself as a small lump around or on either side of which a ligature can be drawn and easy resection performed, but as a complicated condition presenting the most complex variations.

In cases at or near term the life of the child is a consideration of great importance. Although voluminous arguments have been advanced advocating interference while the child is living, no definite rule can be laid down on this subject, and the peculiarity of each individual case must be the guide to the course to pursue. It is justly held by most humane surgeons that the life of the child should be held subordinate to that of the mother, and that, if extra risks are to be encountered by the latter in order to save the infant, it must be clearly understood that the responsibility must not rest upon the physician managing the case.

When an advanced case comes under observation for the first time, say at the sixth month of gestation, shall the surgeon wait until the eighth month, and operate with the intention of saving the life of mother and child, or shall he operate at once, or shall he wait, as advised by some authorities, until spurious labor has occurred, that there may be less risk in the operation? These questions are most perplexing, but many patients present certain peculiarities or conditions that may aid us in reaching a conclusion.

The condition here existing is materially different from that arising where a Cæsarean operation is indicated, for in advanced ectopic gestation the danger to the mother is infinitely greater while the life of the child is of minimum value, as has been sufficiently proved by the researches of Harris, of Philadelphia.

A woman may be so reduced by repeated attacks of circumscribed peritonitis, recurrent moderate hemorrhages, and excessive pain that she can neither endure an operation nor continue in her present condition. In such a case, and there are such, the proper treatment is to resort to the old method; pick out some prominent fœtal part, either abdominally or vaginally; insert a hypodermic needle deeply into the part, with aseptic precautions, and inject sufficient morphia, say half a grain, to kill the child, but not enough to harm the mother. If the child dies, placental souffle will disappear, the pain will subside, some considerable part of the liquor amnii will be absorbed, the dyspnœa will become less, and no more hemorrhages will occur, and in three or four weeks an operation can easily be performed.

With a woman of strength and good health, with a child presenting favorably, and with a placenta that can apparently be easily avoided, the writer would advise endeavoring to save the child. At best, the dangers are always great, and, unless all symptoms are most favorable, the infant life should be ignored.

Surgical interference in one way or another becomes necessary in almost all cases of advanced ectopic gestation, such interference being generally much safer than nature's efforts at relief. Patients with advanced ectopic gestation do not recover with ease without surgical aid, nor after careful analytical examination is the diagnosis usually obscure.

As the fœtal sac increases in dimensions the liability to sudden rupture, so characteristic in the earlier months, seldom occurs. The abdomen is more completely filled and the adhesions more complete, causing more pressure and leaving less and less free space for large hemorrhages.

Although the general diagnosis of ectopic gestation can usually be made with comparative ease, the difficulty of differentiating the variety becomes more difficult because of the occurrence of frequent small hemorrhages and the presence of irregularly situated masses of exudate, the result of localized peritonitis.

The object of all operations on ectopic gestation is the removal of the whole gestation sac, and this usually means removal of the affected tube in early cases. In advanced cases this is often impossible, but as the fœtus is the most offending part of the gestation it is always removed, and, as absorption of the placenta and sac is a slow and more or less dangerous process, they should also be removed when possible.

Hemorrhage is the greatest danger in these operations, and, therefore, avoidance of the placental site when practicable is of the utmost importance. This danger is almost entirely eliminated soon after the death of the child, and the most favorable time to operate is after that occurrence, but before definite signs of sepsis become manifest. Wait two or three weeks, if possible, until the placental souffle has ceased, but be ready to operate at the least indication of sepsis.

Because of this liability to hemorrhage, all these operations must be performed quickly and the parts brought well into view; therefore, in aseptic cases, which are those that bleed, when the child is supposed to be living, abdominal section is almost always the operation of choice.

When the child is dead and the placental souffle extinguished, it may occasionally be found advisable to operate per vaginam if the child is very superficially felt in the posterior cul-de-sac, and there appears to be no bar to extraction by that route because of the size of the fœtus. The cases in which this method is advisable are, however, extremely rare, the difficulty of reaching and properly detaching the placenta being greater by the vaginal route.

The vaginal incision will usually prove available only for the cases in which sepsis is well developed and the gestation sac is filled with putrid material and a decomposed fœtus, and presents in the vagina in such a manner as to form a clear indication.

The abdominal incision need not be median. The surgical sense of the operator must indicate the incision by which the fœtus can best be reached and the placenta avoided.

As removal of the fœtus is a matter of necessity, its location becomes a guide to the character of the operation. It must be remembered, however, that the exact site of the child and its relation to the peritoneum are frequently not determinable until after the incision is made, and sometimes not even then, but nevertheless a proper understanding of the peculiarities of the different varieties of cases materially assists intelligent treatment.

(*a*) WHEN THE FŒTUS IS IN THE UNRUPTURED TUBE. If the gestation is of the infundibular variety there is great doubt whether it can ever develop so as to be included in the category of advanced unruptured tubal pregnancy. The very great majority, if not all, the cases are, therefore, ampullar or interstitial. In the latter variety the uterus ha been dilated, its fundus cut through, and the child extracted. The proper and reasonable treatment, however, is simple abdominal section, made, if practicable, over the most prominent protuberance of the tumor, usually near the median line and low down. The external layer of the sac, or rather the tube, is often found adherent to the anterior wall of the abdomen, and the sac may frequently be freely opened without entering or even perceiving the free abdominal cavity. Every care should be taken to endeavor to avoid the placental site by careful and frequent auscultation before the operation, and by carefully deviating the inner incision, if possible.

The sac being opened, the child is at once extracted, and passed to an assistant, another assistant devoting his attention during this time to the compression of the broad ligament at each side of the sac. The upper border of this ligament on the affected side, if it can be isolated, may be ligated before the sac is opened.

The important step is the management of the placenta. If the child was living when the operation was begun, and the placenta was not materially injured during the operation, great surgical sagacity is needed to determine whether its extraction should be attempted. If it is conveniently situated and the surgeon has faith in his ability to control the blood-supply, it may be rapidly shelled out and a firm packing of gauze relied on to control the hemorrhage. If deeply attached and the large lower vessels are inaccessible because of adhesions, the placenta may be left in place and a firm gauze tampon relied on to check the flow of blood. If the child has been dead for a few days the placenta may be removed at once with only slight risk. No attempt should, as a rule, be made to remove the sac in this variety of cases. If the sac or uterus or both has been extensively lacerated, and hemorrhage seems uncontrollable, it is better to remove the uterus and sac together.

The edges of the incision in the sac should be sewed to the edges of the abdominal wound and the cavity packed with gauze, whether the placenta is removed or left in place. In the latter case, after a few days, the placenta can usually be removed with much less risk. If at any time, however, sepsis occurs, immediate removal of the placenta becomes imperative.

(*b*) When the Fœtus is in the Abdominal Cavity. These are usually, if not always, cases in which the gestation was originally tubal, and in which primary or secondary rupture into the free cavity took place so gradually that no very general hemorrhage occurred, and the fœtus simply lies in a sac formed of the chorion and amnion, which in time becomes attached indiscriminately to most of the adjoining structures. Removal of the sac with the placenta in this variety is very difficult, tedious, and dangerous. After the abdomen is opened a place is found where the vessels are least numerous, the sac opened at this point and the child extracted. Unless the child has been dead some days, no attempt should be made to remove the placenta, which is usually deeply embedded in the pelvis at its original site. The sac is carefully packed with gauze, which is left protruding from the lower angle of the wound. The sac wound is attached, if possible, to the abdominal wound, and the abdominal wall closed down to the gauze at the lower angle. After a few days some of the stitches can be removed, and the placenta extracted, a new packing being carefully placed in the sac. If practicable, the ovarian artery should always be ligated on both sides of the mass.

In the case represented by Fig. 249 the author was enabled to shell out the sac in its entirety, the convalescence being thereby made as simple as the simplest of abdominal sections.

The abdomen should be bandaged rather snugly, excepting exactly opposite the drainage, lest removal of pressure provoke hemorrhage. In some cases the placenta may have spread out rather thinly over a great part of the anterior surface of the thin sac, and may be encountered above at almost all points.

If the child is small and packed down in the pelvis, and appears within easy reach by the vagina, it may in rare instances be extracted with more ease through a vaginal incision.

(*c*) WHEN THE FŒTUS IS SUBPERITONEAL. The treatment differs but little from that of the varieties just described; but mention should be made here of two points: As the peritoneum is pushed upward and toward the unaffected side, the incision must be very low and often somewhat oblique, so as to reach the sac without entering the general cavity. The mass cannot be removed, because it is undefined, the membranes and peritoneum having become blended and fused together so as usually to obliterate even the semblance of a sac.

The operations just described are frequently extremely hazardous, and it is well to bear in mind that the primary object of interference is the removal of the fœtus. At this juncture the exact conditions of the patient must carefully but quickly be determined. If the operation is then proceeded with, it may be necessary at a moment's notice to leave the removal of the sac unfinished and trust to firm packing with gauze to control the hemorrhage. Some operators have simply tied off the umbilical cord as near the placenta as practicable and have closed both sac and abdominal wall without drainage, and with reasonable success, although the advent of sepsis renders early reopening and placental extraction necessary in the majority of cases.

When in an advanced ectopic gestation the fœtus is dead and symptoms of sepsis make it manifest that suppuration has occurred, the sac should be opened, all its contents removed, and drainage established. Whether this should be done through an abdominal or a vaginal incision depends upon the peculiarities of the individual case. Ordinary surgical sense must enable the operator to determine the easier route, for with due precautions regarding the rules of asepsis the easier method is generally the safer. The proper combination of the two may be advisable; for example, with a great deal of pus presenting plainly in the direction of the vagina, and a large fœtus, it may be better to make an incision below and evacuate the most of the liquid contents, or have a competent assistant do this, and immediately open above and extract the child.

If pus has already found its way into the bladder, and the fœtus is much macerated, and already partially in the viscus, the latter may be opened from the vagina and the child extracted piecemeal. If the same accident has occurred by way of the rectum, the anus may be dilated and delivery be effected, or rather assisted, from that direction. Or vaginal or abdominal incision may be made if these other methods seem impracti able or too dangerous. Common sense and surgical ability point out the direction attended with the least risk.

When a patient formerly the victim of ectopic gestation comes under our observation only after the fœtus has become mummified or has undergone adipocere or calcareous formation, if the symptoms demand interference, the operative indications already presented as applying to a recently dead fœtus will suffice.

REPEATED ECTOPIC GESTATION.

A number of instances are recorded in which one tube having been removed for ectopic gestation, impregnation has occurred at a later date in the remaining tube, as has been determined by operation or autopsy. Several cases have also been reported in which undoubted proof has been furnished of two or even three gestations in the same tube. Uterine pregnancy in the presence of a retained fœtus, the result of a previous extra-uterine pregnancy, has been frequently noted. This may interfere mechanically with delivery, and its removal may become necessary.

Twin Ectopic Gestation. It is claimed that twin pregnancies may occur outside of, the same as within, the uterus, but recorded cases of the kind are rare, and very few of these are so perfectly described that their validity is indubitable.

Concurrent Ectopic and Uterine Gestation. Concurrent ectopic and uterine pregnancy may progress equally even to full term, or either fœtus may prematurely perish. The treatment of such cases when pregnancy is advanced presents the most formidable complication known to the obstetric surgeon. There is no recorded instance of the survival of a mother after removal *on the same day* of two living children at or near term, one being intra-uterine and the other extra-uterine. Although text-books do not prescribe the course to pursue, this experience furnishes an indication for treatment.

Two courses may be followed: 1. As soon as the diagnosis has been established, the extra-uterine fœtus may be sacrificed. It is rare that the advanced extra-uterine fœtus cannot be safely reached with a fine-exploring-needle. Sufficient morphin, say one-third to one-half a grain, may in this way be injected into the body of the child, thus destroying its life without injuring the mother. Ten days or two weeks later, or at the slightest indication of sepsis, uterine contractions may be gently and carefully brought on, and a reasonable chance thereby be given to both the uterine child (if it be viable) and the mother. The extra-uterine fœtus can be dealt with later, according to the indications. Even if interference becomes necessary very soon after delivery, this secondary operation would be much more likely to be successful because of the probable elimination of abdominal hemorrhage, which is the predominant danger in all such cases.

2. Labor may be carefully induced and the ectopic gestation ignored and treated independently at a later period. A case was reported from Chrobak's Clinic in February, 1896, in which abdominal section was performed on a woman who had been delivered of her uterine child five days before, and a living child extracted from the abdomen. It was

found necessary to remove the uterus with the gestation-sac. Mother and both children survived.

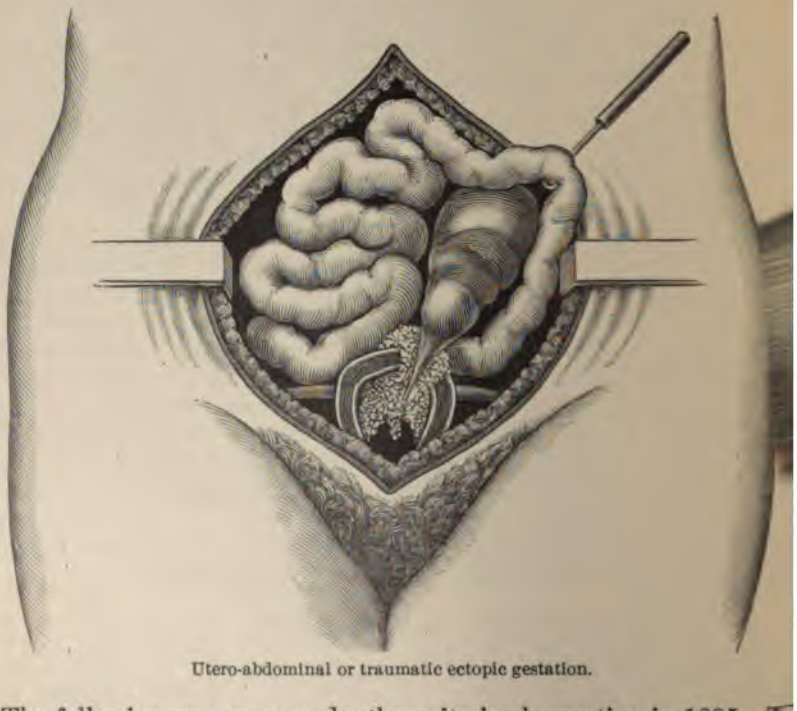
The general advice may be given : *Never operate on an advanced living ectopic gestation in the presence of an advanced living concurrent uterine pregnancy.*

Cornual Pregnancy. Arrest in the development or failure of coalescence of the Müllerian ducts in fœtal life may result in what is known as a bicornate uterus. When pregnancy occurs in one of the horns of such a uterus, the pregnancy may result in normal delivery, providing the horn is well developed. If, however, the horn is rudimentary and does not communicate freely and properly with the lower genital tract, we have a condition so closely resembling real ectopic gestation that it is usually described in the treatment of this subject.

The symptoms, course, and treatment of this condition require no further consideration than the statement that it is to all intents and purposes an ectopic gestation, presenting the same signs and requiring similar treatment.

Utero-abdominal or Traumatic Ectopic Gestation. A pregnant uterus may rupture, the fœtus may escape and develop in the abdominal cavity, the placenta retaining sufficient attachment to nourish the child. Leopold has reported such a case operated upon at term.

FIG. 250.



Utero-abdominal or traumatic ectopic gestation.

The following case came under the writer's observation in 1895 : T
patient, in the desire to terminate an existing pregnancy, introduced
sharp instrument into the uterus when about seven weeks pregna

and a half months of intermittent suffering attended with eptic symptoms, an operation was performed which revealed on represented in Fig. 250. The fœtal sac still intact, about ır and a half months advanced, was found in the free abdom-·, where it had been developing since the injury which caused on from the uterus. The placenta was still adherent to its te, but had become attached to the uterine rent and to the ːxternal uterine surface.

CHAPTER XVIII.

DISEASES OF PREGNANCY.

THE diseases of pregnancy include only those morbid processes which find their causes in the gravid state itself, and which would tend to disappear were the gestation brought to a close. All pre-existing disorders, as well as those of non-gravid origin, are considered under the head of Complications of Pregnancy.

Toxæmia of Pregnancy.

This is one of the most important of the diseases of pregnancy, owing to the fact that there is a growing tendency to look upon toxicity of the maternal blood as an underlying element in the production of almost every disease mentioned in this chapter. If, then, the most important diseases of pregnancy may be only symptoms of toxæmia, we should carefully look into the conditions which favor auto-intoxication.

The metabolic processes of the body are continually producing a large quantity and variety of waste-material, which, after passing through complicated transformations, is eliminated through the intestines, skin, kidneys, lungs, and liver. The fact that these waste-products are exceedingly poisonous is proved by the appearance of grave symptoms when elimination from the body falls below a certain standard, and also by observing the results of the artificial inoculation of animals with excreted material. The study of the physiology of excretion shows us two ways in which the animal organism may be exposed to the dangers of auto-intoxication. First, that great transforming organ, the liver, may fail to perform its duty, so that the products of tissue-waste are not converted into a chemical structure appropriate to the functions of the eliminative organs, and there will accumulate within the body certain poisonous precursors of urea. Second, through disease or functional insufficiency the eliminative organs themselves may not protect the organism against the development of a dangerous toxæmia resulting from retention of waste-products in the blood. There are two reasons why the pregnant woman is peculiarly exposed to the dangers of auto-intoxication. First, her blood contains an increased amount of poisonous material due to (*a*) stimulation of the metabolic processes to provide for the nourishment and protection of the fœtus, and (*b*) the tissue-waste passing into her circulation from the fœtus. Second, as the uterus enlarges there must be a constantly increasing intra-abdominal pressure with a growing liability to mechanical interference with the action of the liver, bowels, and kidneys or, as some writers suggest, the uterus may produce reflexly a spasmodic contraction of the vessels. Renal and hepatic functions depend upon the amount of blood flowing through the organs, and are lessened by the diminished circulation, however produced. In short, the pregnant woman is exposed to an increase of waste plus diminution of excretion. Ordinarily this increase of the demands made upon the eliminative organs results in their organic hypertrophy; but there are certain women who suffer from habitual deficiency of excretion, and whose liver and kidneys do not respond when called upon for more work; in such cases further interference through pressure has disastrous results.

There are many facts which show there is nothing fanciful about the statements made in the preceding paragraph. Van de Velde demonstrated by experiments upon rabbits that there is an increase of the toxicity in the blood obtained from pregnant women; Charpentier's inoculation-tests also prove the same. When symptoms of toxæmia appear the toxicity of the blood is found to be greater: the urine of pregnancy is more toxic than that passed by the non-pregnant woman, and in cases of toxæmia the toxicity of the urine diminishes in the same proportion as that of the blood increases. Auto-intoxication more frequently appears in those cases characterized by great distention of the uterus, as multiple pregnancies and hydramnios; and, finally, death of the fœtus or the artificial induction of abortion usually leads to a cessation of the toxic symptoms.

NATURE OF THE POISONS. Notwithstanding much investigation, the toxic material has not been isolated, and this part of the subject is in confusion. Tissue-waste forms toxins of alkaloidal nature and of complicated structure; some of them are supposed to be potassium compounds. From the fact that bacteria have been found in the blood of toxic patients micro-organisms have been suggested as causing the disease; but the probability is that the presence of the bacteria is the result, and not the cause, for toxic blood favors infection by supplying a favorable culture-medium. It is important to bear in mind that not one, but several toxins are to be held responsible, and that the poisonous principles may consist of intermediate products, such as creatin and creatinin. Pinard considers that the disorders of pregnancy are related to a physiologic insufficiency of the liver, and are really symptoms of hepatic break-down; he characterizes the auto-intoxication of pregnancy as hepato-toxæmia.

The effect of the toxins upon the tissues is that of irritation, especially marked in the case of the nervous system: the eliminative organs themselves often are much disturbed either from excess of toxic material or from their attempt to deal with substances insufficiently prepared for excretion. Marked congestion of the liver and kidneys has been noted, and yet, even in the severest cases, lesions of structure may be slight or entirely absent. In some instances the toxins have produced a nephritis, the symptoms of which have appeared subsequent to the pregnancy. The action of the toxins upon the intestines and skin produces temporary irritation rather than pathologic change.

SYMPTOMS AND DIAGNOSIS. From what has been said, the symptoms and their *rationale* are easy to understand. The nervous system furnishes the most striking phenomena, consisting of headache, dizziness, tinnitus, disturbances of vision, and mental irritability: if these symptoms reach a certain degree of severity, the pre-eclamptic stage appears, for a description of which the reader should consult the chapter dealing with Eclampsia.

The symptoms arising from the digestive organs are nausea, vomiting, and, less frequently, salivation and diarrhœa. A general pruritus is not an uncommon evidence of the irritation of the skin, and in some instances bronzing of the surface may appear. Anæmia and jaundice are often present. Swelling of the feet and legs usually is associated with toxæmia, but this condition may be quite independent of the auto-infection.

The most important signs upon which the diagnosis rests come from urinalysis. The symptoms mentioned in the preceding paragraph are accompanied by a diminution of the amount of urea and total solids, although, as has been pointed out, the fault may not lie with the kidneys, but with the insufficiency of the hepatic functions. While a description of the methods employed in urinalysis would be out of place, it may be well to mention some leading points. The analysis must always be based upon a twenty-four hour sample, in order to make the needful quantitative tests: the presence or absence of albumin is not the chief thing to be determined, but rather the efficiency of renal action. Albuminuria frequently is a feature of toxæmia; but, on the other hand, there are severe cases in which no albumin has been detected. In the urine of pregnant women the urea may vary from 1.4 to 2 per cent.; an amount less than 1 per cent. indicates a dangerous degree of toxicity of the blood. It is not implied that urea is the poison producing the unfavorable symptoms, but only that the urea-excretion constitutes a reliable clinical index of elimination. A microscopic examination must never be omitted in order to obtain information concerning the state of the kidney-tissues.

Bouffe de Sanite-Blaise gives the following symptoms as diagnostic of hepato-toxæmia: 1. A progressive diminution of the excretion of urea. 2. Increase in the proportion of uric acid. 3. The presence of such extractives as leucin, tyrosin, xanthin, and hypoxanthin. 4. Urobiluria. 5. Alimentary glycosuria; *i. e.*, if the patient ingests a fixed amount of glucose daily, a large portion of it will appear in the urine, because the liver is unable to perform its full glycogenic functions. 6. Indicanuria. 7. Peptonuria. 8. Albuminuria.

Prophylaxis. An appreciation of the importance of avoiding the dangers involved in toxic conditions makes this part of our subject of great importance. Prophylaxis consists in limiting the amount of waste-matter and in providing for free elimination. Careful attention to the details set forth in the chapter on Hygiene and Management of Pregnancy constitutes a great part of the prophylaxis.

The diet should be simple, and should not include a large amount o meat. It may consist of lamb, mutton, fish, oysters, raw and cooke fruit, together with the lighter vegetables: pastry sweets, cheese, an rich sauces or gravies should be prohibited. Some of the cereals an whole wheat-bread are useful in overcoming a tendency to constipation It is better for the patient to take several light meals than to overloa her stomach at any one time. The intelligent physician will have n trouble in furnishing his patient with a written dietary suitable both t her needs and inclinations. Milk is extremely useful when it agree and the addition of Vichy or soda-water will make it more palatable. Tea and coffee should not be taken more than once a day, and should be forbidden entirely if there are signs of digestive disturbance. The physician should insist that his patient drink water freely, and it is well to give definite directions on this point, as most women habitually take too small an amount of fluids. The patient may gradually be induced to take from one to two quarts in the twenty-four hours; lemonade or the effervescing waters may be used freely; it is often a good plan to give the patient a simple tablet to dissolve in the water, so that she may be impressed with the importance of the treatment.

Pains must be taken that the patient has a daily evacuation from the bowels. The diet and free use of fluids will do much toward accomplishing this end; but, if necessary, some simple laxative, such as cascara or compound liquorice powder, may be prescribed; in certain cases enemata are more satisfactory than the administration of drugs by the mouth. Elimination through the skin is promoted by frequent bathing, following by gentle friction with a rough towel and an occasional use of the cabinet. As the lungs play an active part in elimination, the patient should be in the open air several hours a day, and should avoid all crowded assemblies where the ventilation is bad. Pressure upon the body should be diminished by wearing the clothing as loose as possible; the underclothing should be of flannel.

The supervision of the urinary secretion is the most important part of prophylaxis. Urinalysis should be performed every two weeks, and on every occasion when there arise symptoms; only in this way can we get early warning and take steps to prevent the development of serious danger.

Treatment of the Toxic Condition. The appearance of nervous symptoms in conjunction with diminution of the amount of urea and solids, as shown by urinalysis, calls for prompt and energetic treatment. The diet must at once be restricted to milk, except in the mildest cases, in which bread, fruit, fish, oysters, and gruels may be permitted. Free movements of the bowels must be evoked by the use of calomel, sulphate of magnesium, or jalap. The following formula for an enema is mentioned by Davis, and is often efficient:

Magnesium sulphate	2 ounces;
Glycerin	2 "
Spirit of turpentine	½ ounce;
Castile soapsuds	1 quart.

The dose of the purgative must be regulated to the needs of the case, and it should be remembered that too active catharsis may bring on contractions of the uterus.

Hot-air baths or hot packs, combined with the free administration of water, are the best means for aiding elimination through the skin and at the same time for promoting the flow of blood through the kidneys by relieving venous congestion, profuse sweating often being followed by an increase in the amount of urinary secretion. Grandin advises hot saline irrigation of the bowel, eight to ten gallons of a 1 per cent. solution being employed; this is very useful when the patient is vomiting, and so cannot retain water given by mouth. Hypodermocleisis also is recommended, as well as high-up injections into the bowel of small amounts of normal salt solution frequently repeated.

Renal functions may be stimulated by small doses of calomel, which drug may have some effect upon the hepatic activity, and also by the use of infusion of digitalis. Dry cups help to relieve renal congestion, and nitroglycerine is recommended for cases in which a spasmodic state of the vessels is supposed to be present. Diuretics containing potash should not be employed, as it has been suggested that some of the poisonous products may be combinations of potassium. To stimulate oxidation, inhalations of oxygen may be tried.

When there are great irritability and restlessness the administration of chloral per rectum may have a soothing effect; but the main reliance must be upon removing the toxins, and not upon drugs which may both mask the symptoms and lock up secretion; of the succedanea of opium, only codein is allowable.

If the efforts to promote excretion are successful and the symptoms disappear, the case still calls for constant watchfulness on the part of the physician, who must carry out every detail described under the head of prophylaxis. Patients who have once suffered from toxæmia are liable to recurrences of the condition either later in the pregnancy or in a subsequent gestation. Anæmia is frequently the result of the action of toxins upon the blood, and demands the administration of iron and arsenic.

There are some cases of toxæmia in which the symptoms increase in severity in spite of the most intelligent treatment, so that we are obliged to employ our final resource, namely, artificial termination of the pregnancy. Indications for the induction of abortion are continued vomiting, great weakness, and the development of the prodromata of eclampsia. Reliable counsel should be sought before so decided a step is taken. In conclusion, we wish to say that since the causes and results of toxæmia may have been understood and prophylaxis attended to there has been a decrease in the frequency and severity of the diseases of pregnancy.

Albuminuria.

Although albuminuria is said to exist in 5 per cent. of all pregnancies, there are but two conditions in which it is of special significance: First, when it is caused by an excess of toxins passing out through the kidney-tissues, associated with diminished excretion, as described in the preceding paragraphs. Second, when the albumin is found in conjunction with tube-casts and is a part of the evidence of nephritis.

To account for the cases of albuminuria not falling under these two heads various explanations are offered, all of which assume that the circulation through the kidneys is impeded by some condition arising from pregnancy. We know that the pressure from ovarian or uterine tumors often causes a temporary albuminuria; the tumor of pregnancy may act the same way, and we are not surprised to find that in a large proportion of the cases the albuminuria does not appear until the later months of gestation, when the intra-abdominal pressure is greatest. Any condition which causes an extra degree of uterine enlargement, such as multiple pregnancies or hydramnios, predisposes to albuminuria; primiparæ, especially those with rigid abdominal walls, frequently have albuminuria during the latter half of pregnancy. On the other hand, it is only fair to mention that Allbutt does not believe in pressure as a cause for renal disturbance, on the ground that the veins of the kidney are not easily pressed upon, and that albuminuria is often absent when the intra-abdominal pressure seems to be very great. Allbutt thinks that poisons absorbed from the intestinal tract are responsible for the kidney-disturbance. The circulation in the kidneys may be impeded from other causes than pressure, among which may be mentioned a spasm of the vessels due to reflex stimulation coming from the pelvis or from exposure to wet and cold; but these etiologic factors are questionable and of trifling importance. The way in which the disordered circulation leads to albuminuria is not perfectly clear, but there probably results some interference in the vital processes of the cells allowing the albumin to pass out. We must bear in mind that albumin is not a normal constituent of the urine, and even if no morbid symptoms are present its appearance demands the attention of the physician. Hemorrhages into the placenta have been observed in albuminuric cases; they probably are dependent upon conditions underlying the albuminuria.

DIAGNOSIS. With proper attention to the care of the pregnant woman the physician never can overlook the presence of albumin in the urine; the ordinary chemic tests are all that are necessary for diagnosis. The important point is to be certain that the albumin comes from the kidney, as a great many gravid women suffer from a slight leucorrhœa, which may contaminate the urine and invalidate the conclusions. In cases of doubt the surest way is to draw a specimen of urine by catheter, using all due aseptic precautions; or else direct the patient, before urinating, to take a vaginal douche and afterward introduce a small tampon of absorbent cotton into the lower portion of the vagina; the cotton should have a string attached, so that the patient can remove the tampon. The presence of a cystitis may be excluded by the history of the case and by a complete urinalysis. As the significance of albumin depends upon its relation to the excretion of urea, all cases of albuminuria must be frequently and thoroughly examined.

TREATMENT. Albuminuria itself does not call for any special treatment except when a sign of some serious condition. The treatment of toxæmia has been discussed. A slight albuminuria in the latter months of pregnancy, even if associated with œdema of the lower extremities, need not be looked upon as serious in the absence of other symptoms. Where the albuminuria seems dependent upon a weak circulation the cardiac stimulants are indicated as in the non-pregnant state.

Disorders of Digestion.

Nausea and Vomiting of Pregnancy. A certain degree of nausea and vomiting is considered by many a part of the physiologic processes of early pregnancy: slight gastric disturbances are mentioned as having a certain diagnostic value. What is known as simple vomiting is that form of disorder appearing near the beginning of gestation and ceasing about the middle; its symptoms are not severe nor its consequences serious. A second form is known as hyperemesis gravidarum, pernicious or uncontrollable vomiting, and it differs from the first in being more severe and of longer duration; its evil results are implied in the term pernicious. There are many cases in which the first form passes gradually into the second, so that a border-line is difficult to fix. On the other hand, many women pass through pregnancy with no disturbance of their gastric functions, and modern authorities are reaching the conclusion that nausea and vomiting in pregnancy are pathologic and not physiologic phenomena, and that the two forms depend upon the same general causes and differ only in degree.

Simple Vomiting. In rare instances the symptoms begin a few days after conception, but more frequently not until the end of the first month coincident with suppression of the menses. The nausea and vomiting frequently are present on waking in the morning, or may not come on until after eating breakfast. After one or two attacks of emesis the patient may be entirely relieved, take food regularly through the day, and go through the same performance the next morning. In the mildest cases there is nothing but a little temporary nausea every morning which passes off by noon. In the severe forms more or less vomiting continues throughout the twenty-four hours, attacks being brought on by the ingestion or mere sight of food, and also by physical exertion or strong emotion of any kind. There are exceptional cases, which may be classed as nocturnal, in which the patient is afflicted with emesis after retiring at night. In the case of early morning vomiting the ejected matter consists of mucus, usually of a strongly acid reaction; at other times partially digested food appears in the vomitus; if the emesis is prolonged, the ejected material is stained with bile.

The features which entitle this form of nausea to be classed as simple are, first, the tendency to spontaneous cure at the fourth month when the uterus rises out of the pelvis, and, second, the non-impairment of the woman's nutrition to any dangerous extent.

Hyperemesis Gravidarum. The vomiting is classed as pernicious when the nutrition of the mother and child suffers and the affection persists. The disease may be divided into three stages:

First Stage. This stage begins with the features of simple vomiting and grows progressively more severe. The vomiting appears upon every attempt to take either solid or liquid nourishment, with the result that the patient soon develops an aversion to food of all kinds. At first the character of the vomitus is as described in the remarks on simple vomiting; but later streaks of blood and masses of coffee-ground-looking material appear in the ejecta, the latter being the result of blood-disintegration. Ptyalism and profuse diarrhœa may be associated symptoms, and in the movements of the bowels the coffee-ground material may appear. The constant vomiting, now independent of any efforts at taking food, produces a burning sensation beneath the sternum, and the epigastric region becomes extremely sensitive to pressure. Sometimes there are lulls in the course of the disease, during which the patient takes and retains food, and the physician is deluded into the belief that recovery has set in. This apparent improvement is only temporary, however, and as the disease progresses the patient is unable even to raise her head from the pillow without being nauseated; emaciation becomes apparent; there is a feeling of lassitude or weakness; the pulse is rapid and the temperature often subnormal.

Second Stage. A fever, presumably of toxic origin, marks the access of this stage: at first the elevation of temperature occurs only at night, but later it is continuous, reaching as high as 103° F.; the pulse-rate may be 140. The symptoms now resemble those of pernicious anæmia, there being the coffee-ground vomit and dejecta, jaundice, sordes upon the teeth, and purpuric extravasations. The weakness of the second stage is more pronounced, so that even slight efforts are attended with syncope. The reflexes usually are much increased; the urine is scanty in amount, of high specific gravity, and usually contains albumin and casts. There may be present abnormal constituents, the same as those mentioned under the head of hepato-toxæmia. The drain of fluids from the body, due to the vomiting and diarrhœa, causes the patient to complain of great thirst.

Third Stage. Death frequently cuts short the case before this stage is reached. The peculiar feature of this stage is the cessation of the vomiting owing to the utter exhaustion of the vomiting-centre. The rise of temperature is continuous, but the pulse shows the sign of approaching collapse by becoming weak, rapid, and irregular. The mental state is usually one of apathy, though occasionally there are delirium and delusions. Coma precedes the fatal issue.

CAUSES OF THE NAUSEA AND VOMITING OF PREGNANCY. All explanations of the gastric disturbance of pregnancy must take into account both the condition of the nerve-centres and peripheral irritation. Even when the vomiting-centre is in its normal state we can understand how it may be stimulated into activity by a powerful reflex influence, and there is an abundance of clinical evidence to prove that pathologic uterine conditions may be efficient reflex sources of gastric disorders. At the beginning of pregnancy the woman's nervous system often is in a condition of unstable equilibrium, possibly due to circulatory changes, so that such physiologic stimuli as distention and change in the position of the uterus may disturb the vomiting-centre and lead to those simple forms of stomach irritability. After a few weeks or months the nervous system becomes adjusted to the new conditions, and physiologic stimuli no longer produce pathologic manifestations. More powerful reflex action will result when the uterine modifications of pregnancy are interfered with by abnormal pelvic conditions, such as adhesions binding down the fundus or by a retroversion allowing the organ to become crowded beneath the promontory of the sacrum: in these pathologic conditions we do not need to assume the existence of an oversensitiveness of the nerve-cells, but when such is the case there will naturally be an aggravation of all the symptoms. When we come to those severer forms of vomiting classed as pernicious, the modern theories lay particular stress upon those conditions which render the nerve-centres irritable, and which are included in the term auto-intoxication. Several writers claim that hyperemesis is a direct evidence of auto-intoxication, and particularly of hepatic break-down. If the fœtus dies in utero, the trouble usually ceases. Horwitz points out that pernicious vomiting occurs at a time when the uterus is not distended; this fact does not invalidate the theory that auto-intoxication is the underlying element, but merely shows that toxæmia may occur independently of much increase of intra-abdominal pressure. Dirmose considers that intestinal toxæmia is the underlying evil. At the present stage of our knowledge it is unprofitable to discuss the question whether the hyperemesis of pregnancy is produced by one form of poisoning or another as long as we bear in mind that there is a practical unanimity of opinion that hyperemesis, in the vast majority of cases, is a symptom of toxæmia and not really a separate disease. The toxins act in two ways: first, they are themselves irritants; second, they make the centres extremely sensitive to all reflex stimuli. It is a significant fact that those pregnant women whose elimination is habitually active seldom suffer from even the mild forms of gastric disturbance. It is probable that most cases of simple vomiting are at first entirely dependent upon reflex causes, but after a time the frequent attacks of emesis may produce such disturbances of digestion and elimination as to lead to toxæmia: thus, the simple form gradually may pass into the pernicious.

DIAGNOSIS. The main point at issue in the diagnosis is whether the nausea and vomiting are related to the pregnant condition or independent of it. A thorough pelvic examination should be made and abnormal sources of irritation sought for; the urine should be measured and completely examined. The evidences of complicating diseases, such as gastric ulcer, gastric cancer, cirrhosis of the liver, or nephritis, must be looked for; coffee-ground material in the vomit or dejecta should be examined for disintegrated blood-corpuscles, in order to diagnose the stage of the affection.

PROGNOSIS. The term simple vomiting implies the presence of an affection the prognosis of which is good; as has been stated, this form of the disorder tends to spontaneous cure without injury to the mother or child. In the pernicious form of vomiting the prognosis is always grave, the mortality being given from 30 per cent. to 60 per cent. Probably, treatment based on the theory of toxæmia will give us more favorable results and render the prognosis less serious. The affection may lead to a spontaneous abortion, with a resulting cure; but such an outcome is not at all common. The most unfavorable symptoms are emaciation, feeble pulse, epigastric pain, coffee-ground vomit, and a low elimination of urea.

TREATMENT. The possibility of a toxic element underlying the nausea and vomiting of pregnancy should always lead the physician to investigate even slight disturbances of the stomach when appearing in gravid patients; he must look upon all pronounced forms of digestive disorders as pathologic. Another influence of modern ideas upon this subject is to impress upon us the comparative uselessness of drugs and greatly curtail the long list of medicines found in all the older textbooks. We cannot divide the treatment into that of simple and pernicious vomiting, because clinically one form fades into the other; all treatment is directed toward diminishing the sources of peripheral irritation and removing the undue susceptibility of the nerve-centres.

1. *Treatment Directed to Removing Sources of Peripheral Irritation.* In severe cases it is best to keep the patient in bed and free from all noise or excitement; sometimes even light must be excluded from the room. In the mild forms of morning sickness the woman may escape the vomiting if she eats her breakfast in bed and remains quiet until noon: in the severest cases it is necessary to keep the patient in bed in

order to save her strength, as well as to keep her free from disturbing influences. An important part of the treatment falling under this head consists in attention to the patient's pelvic conditions. At the onset of the affection a careful bimanual exploration of the pelvis should be performed, so that no abnormality may remain undetected. If the uterus is found to be displaced backward and non-adherent, the bladder and rectum should be emptied and the womb replaced by bimanual manipulation: in difficult cases anæsthesia may be necessary. After the uterus is in proper position a pessary should be introduced and worn until the organ has become too large to fall into the pelvis again. When the uterus is so large that the fundus will not readily swing by the promontory of the sacrum the treatment may require several sittings, each gain in elevation being maintained by means of a snug vaginal tampon. The knee-chest position may be of material aid. In cases which have advanced so far that symptoms of incarceration have appeared and treatment has failed, M. D. Mann advises abdominal section, followed by manual elevation of the fundus. In displacement complicated by the existence of pelvic adhesions, tamponing the vagina with cotton or wool is indicated; the upper tampons should be soaked with a 10 per cent. solution of ichthyol in glycerin. The medicament will promote a free discharge of serum from the tissues, relieving congestion and stimulating absorption; the tampon may be allowed to remain for forty-eight hours at a time if the cotton be sterile and well sprinkled with iodoform. It is noticed that this treatment often affords relief from vomiting even before the conditions are entirely restored to normal. If local treatment fails to free the uterus, vaginal section should be performed and the adhesions broken by the finger introduced through the posterior cul-de-sac. When the uterus is anteflexed and crowded down into the pelvis, Hewitt recommends the use of an air-ball pessary, which is inflated after its introduction into the pelvis; tamponing may be substituted for the pessary.

In some of the cases nothing pathologic can be discovered other than a cervical discharge associated with more or less erosion about the external os. In these instances local applications to the uterus may be tried. The cotton-wrapped applicator, after being dipped in iodine or a solution of silver nitrate (30 grains to the ounce), is inserted as far as the internal os and the cervical endometrium thoroughly treated; the portio vaginalis also should be painted with the solution. A contracted or rigid condition of the tissues about the cervical canal may be the starting-point of undue stimulation, and has led to the treatment by dilatation. Under anæsthesia a steel dilator is introduced and the lower portion of the canal dilated to a degree sufficient for the admission of the finger; instead of the steel dilator, strips of iodoform gauze are sometimes employed. All local measures must be carried out with attention to aseptic details, and the family or friends should be informed that the treatment, especially dilatation, may result in an abortion.

2. *Treatment Directed to Removing the Irritability of the Nerve-centres.* In the mild form of simple vomiting it is justifiable to employ some of the remedies which diminish reflex action, such as chloral and sodium bromide; but in those cases showing signs of the pernicious form the dietetic and general treatment is directed toward overcoming the condi-

tion of toxæmia resulting from deficient elimination. It must be remembered that the vomiting and diarrhœa may represent efforts at excretion, and therefore the stomach and bowels are not the points for therapeutic attack. For the details of the antitoxic treatment the reader is referred to the article on Toxæmia.

Dietetics. This department is regulated by the condition of actual or threatened toxæmia, but we must remember that prolonged vomiting will leave the stomach extremely irritable for a time and call for a light and easily digested diet. Milk in some form is our main reliance, but beef peptonoids or somatose may be tried; sometimes the patient will retain the articles of food which seem to be most unsuitable. When the stomach shows itself absolutely intolerant, rectal alimentation must be used: four to six ounces of nutrient material may be injected every four or six hours; in such cases there should be daily irrigations of the bowels with warm salt solution.

Drugs. Drugs should be used with extreme caution, except such as are of aid in the eliminative treatment; intestinal antiseptics may be employed on the theory of intestinal toxæmia being the particular fault. The following drugs may be mentioned as being extensively used: cocaine in doses of $\frac{1}{8}$ grain; oxalate of cerium, gr. x, three or four times a day; dilute hydrocyanic acid, wine of ipecac, and carbolic acid given in drop doses well diluted and frequently repeated. Washing out the stomach through a tube is sometimes an excellent measure; at the close of the lavage some water having calcined magnesia in suspension may be left in the stomach with advantage. Morphine or opium should never be employed, as the result is a masking of symptoms and a locking up of secretions. As a rule, medication addressed to the stomach is beginning at the wrong end of the trouble, a fact well attested by the interminable lists of drugs given in the books and handed down through force of habit. If a gastric catarrh develops, the appropriate treatment should be instituted. In the advanced stages of pernicious vomiting a free use of the cardiac stimulants is demanded.

If, in spite of all efforts of treatment, the case becomes progressively worse, there is no resource left but the induction of abortion or premature labor. This operation should never be performed without the advice of counsel; but, on the other hand, the procedure must not be put off until the patient is so weak that she cannot stand the necessary strain of its performance. No case should be allowed to advance beyond the inception of the second stage, or when the unfavorable symptoms mentioned under prognosis appear; the character of the pulse must be the important guide. In many instances, even after the uterus has been emptied, energetic eliminative measures must be continued for a time, before the vomiting ceases.

Pytalism. A profuse secretion from the salivary glands may be a source of great annoyance during the early part of pregnancy, and in extreme cases the quantity of saliva may amount to one or two quarts during the twenty-four hours. The latest authorities are inclined to include ptyalism among the phenomena of auto-intoxication, there being some toxin which stimulates the salivary glands and is eliminated in the saliva. It may be that the hypersecretion, instead of being excretory, is simply the result of the irritation of oversensitive nerve-centres. The symptoms consist in constant flow from the glands, which necessitates frequent expectoration, or, in severe cases, the wearing of a napkin to catch the fluid constantly dribbling from the angles of the mouth. Ptyalism usually ceases by the fourth or fifth month; in rare cases it has continued throughout the pregnancy and for several months subsequently.

TREATMENT is not very satisfactory, except when removal of the toxæmia puts a stop to the disorder. Belladonna and astringent mouth-washes are sometimes used; a weak galvanic current applied to the salivary glands has been recommended.

Dental Caries. There is no question that pregnancy predisposes to decay of the teeth. The causes ascribed are the demands upon the maternal organism for lime-salts and the action of altered buccal secretion; at the beginning of pregnancy the woman should have her teeth examined and follow the advice of a dentist as to their care, thus diminishing the risk of suffering from facial neuralgia, which is so often aroused by carious teeth. After each meal it is advisable for her to use dental floss and rinse the mouth with some alkaline mouth-wash.

Pyrosis. It is not uncommon for a pregnant woman to be troubled with eructations of a strongly acid fluid, accompanied with a sensation of burning in the epigastrium. This is a reflex disorder of the same nature as the vomiting and nausea. The treatment is removal of any exciting cause, attention to elimination, and the use of alkalies, such as bicarbonate of sodium and aromatic spirits of ammonia. A useful remedy is a gastric sedative powder suggested by C. G. Stockton for cases of hyperchlorhydria; the formula is as follows: cerium oxalate, 1 part; bismuth subcarbonate, 2 parts; and light magnesia, 4 parts. Of this, one or two teaspoonfuls should be stirred into a third of a glass of water and taken when the symptom appears.

Pica or Malacia. These are terms describing a peculiar craving for unnatural articles of food, such as coal, chalk, dirt, etc. In the mildest forms of the affection the patient merely displays a fondness for varieties of food which are disliked when she is in the non-pregnant state. Sometimes this craving is a part of other gastric disorders, but it usually may be regarded as of psychic origin.

TREATMENT. There is no special treatment except to make efforts toward preventing the patient from injuring herself.

Anorexia, Diarrhœa, and Constipation, and similar disorders do not call for extended comment; they are usually controlled by proper attention to the hygiene of pregnancy. Diarrhœa as a symptom of toxæmia has been mentioned. The increased intra-abdominal pressure often causes constipation, which should be overcome with regulation of the diet and administration of laxatives.

Disorders of Circulation.

Palpitation. This is very common at some time during pregnancy; it may be reflex or the effect of direct pressure upon the diaphragm; it is more often experienced in the latter part of pregnancy and when the uterus is overdistended. In some cases it is of gastric origin or related to the condition of anæmia or hysteria.

TREATMENT. The treatment consists of removal of the cause when possible: aromatic spirit of ammonia constitutes a useful remedy for the time being.

Syncope. Fainting may be associated with palpitation, and is usually of purely nervous origin.

TREATMENT is the same as in the non-pregnant.

Hemorrhoids and Varicose Veins. As these affections result from mechanical pressure, they are met with in the latter part of pregnancy; the veins of the anal region, the lower extremities, and vulva are the vessels most often enlarged. Gestation is apt to have pronounced effect upon pre-existing varicosities; anæmia, by interfering with the nutrition of the vessel-walls, acts as a contributing cause.

The TREATMENT is merely palliative, as the underlying cause cannot be removed until labor occurs. Hemorrhoids are treated by the avoidance of constipation and the application of soothing ointments, such as the injection of a small amount of linseed oil or the following:

Morphine	gr. v.
Muriate of cocaine	gr. x.
Calomel	gr. xl.
Vaseline	1 ounce.

Apply locally night and morning.

If there is much itching, a drachm of menthol may be added to the above. For the varicose veins of the legs elastic bandages may be used; occasionally patients are confined to bed for the last few weeks of pregnancy, owing to the great swelling of the lower limbs. There is some danger of external rupture of the vessels in aggravated cases, and the patient should be taught how to apply pressure in order to control hemorrhage, which may be very severe: when rupture takes place into the tissues about the vulva a hæmatoma of large size may be produced. The hæmatoma is best left alone, as absorption usually takes place; in case of suppuration the tumor should be incised, the clots washed out, and the cavity packed with gauze; the packing is renewed every forty-eight hours until healing takes place. The treatment of vulvar hæmatomata during labor is elsewhere described. Radical measures for cure of varicosities are best postponed until after labor, as they are apt to produce uterine contractions.

Anæmia. We can readily understand how important are the blood-changes of pregnancy when we appreciate the demands made upon the maternal blood; upon this fluid tissue all the burdens of nutrition must fall. Like other tissues, the blood increases in order to meet the new requirements laid upon it; at first the increase is chiefly in its watery constituents, but later it becomes richer in both quantity and quality; toward the end of pregnancy the blood is said to contain an excess of fibrin. There are two ways in which anæmia may arise during pregnancy; first, there may be a failure of the necessary modifications to meet the increased demand, thus producing a relative insufficiency of the blood; second, the presence of toxic matter may produce a deterioration of the blood-corpuscles. Bad hygienic conditions are potent predisposing causes. In the study of the anæmia of pregnancy we cannot fail to be impressed with that peculiar feature of pregnancy, namely, the demand for certain modifications, and at the same time the development of conditions which hamper their production.

The anæmia of pregnancy calls for treatment, as the disorder may have marked effect upon both mother and child: its symptoms are the same as when existing in the non-gravid patient, but they are often masked by evidences of other and underlying disorders. It is claimed that a simple anæmia of pregnancy may in some cases develop into the pernicious form.

The TREATMENT consists in careful regulation of the food and excretions of the patient, as well as attention to all the hygienic conditions. Iron, arsenic, and strychnine are the drugs indicated; bone-marrow is valuable in most cases. When other means of relief fail and the disease progresses so as to threaten life, the induction of premature labor must be considered.

Disorders of the Respiratory System.

The disorders of the respiratory system during pregnancy are unimportant and may be dismissed with few words. There may be a reflex cough, which is to be regarded in the same light as nausea and vomiting. When there is no trouble with the lungs or bronchi the treatment is to be addressed to the nervous system; the cause of the reflex stimulation should be removed if possible; the valerianates and codeine are useful in the way of medication.

Dyspnœa. This usually is a symptom of pressure of the gravid uterus upon the diaphragm, appearing late in pregnancy and intensified by overdistention of the uterus from hydramnios or twins.

TREATMENT consists in directing the patient to avoid all excitement or overexertion, in order to lessen the demands made upon the respiratory organs.

Disorders of the Nervous System.

Nervous symptoms have been prominent symptoms of the diseases already considered. Pregnancy makes great demands upon the maternal nervous system, and at the same time exposes the centres to deleterious influences such as were discussed in speaking of toxæmia.

Mental Affections. Hysteria and slight alterations of the nervous system are not uncommon during gestation, and probably in most instances denote increased nervous susceptibility merely or want of equilibrium. The fact that slight mental changes are expected during pregnancy has resulted in a failure to diagnose incipient insanity. Insomnia, irritability of temper, and an alteration of the disposition may represent the prodromal stage of insanity. In investigating the relation between pregnancy and nervous diseases, J. W. Putnam found reports of many cases of gestation-insanity, although the disorder forms but a small per cent. of asylum cases. One hundred and twenty-five out of one hundred and seventy-five of Tuke's cases occurred in primiparæ, and Savage considers that insanity is more frequent when the offspring is male. The type of mental disturbance is usually melancholic, and a suicidal tendency shows itself in about one-half the cases. A growing antipathy toward the husband is a common feature of the disease.

TREATMENT. There is nothing peculiar about the treatment of mental diseases during pregnancy, but as toxæmia is suggested as an underlying cause the maintenance of elimination is important. When suspicious symptoms appear the case should be watched closely, as an entirely unexpected attempt at suicide has been successful through want of observation and precaution on the part of the medical attendant. The prognosis for recovery after labor is good.

Neuralgia. This painful affection constitutes a not infrequent cause of complaint among pregnant women. The pain is most often situated in the face or pelvis. The causes are auto-intoxication, dental caries, abnormal uterine positions, pelvic adhesions, and the presence of hardened feces; anæmia may be an important predisposing element.

TREATMENT consists in removing the cause and underlying conditions. A certain amount of discomfort from pressure in the pelvis or distention of the abdominal walls is unavoidable. The suffering may be relieved by the administration of coal-tar products or codeine; where there are distinct painful areas on the skin counterirritation may prove of benefit. In severe cases morphine must be administered hypodermatically.

Herpes. This unpleasant affection is sometimes developed during gestation; Hardy mentions a patient who was afflicted during nine out of ten pregnancies. The symptoms are the same as those characteristic of the disease among the non-pregnant. Although the affection does not show a tendency to cut short the course of the gestation, it produces a marked depression of the vital powers and calls for supporting measures. That there is usually prompt and spontaneous recovery when labor occurs suggests trial of vigorous eliminative treatment.

PART VI.

PATHOLOGY OF LABOR.

CHAPTER XIX.

ANOMALIES OF THE MECHANISM.

DYSTOCIA is the term applied to labor which, without artificial assistance, would be difficult or impossible, or would be attended with danger to mother or child. It is the opposite of *Eutocia*, which denotes normal labor terminating safely and easily without artificial aid.

Every case of labor is a mechanical problem in which the three main factors are (1) the expelling force, (2) the fœtus which is to be expelled, and (3) the resistance of the parturient canal, which must be overcome before delivery can be effected. When the expelling force is sufficient, and there is no disproportion between the fœtus and the maternal passages, labor proceeds normally. As the fœtus descends through the parturient canal more or less adaptation takes place; the presenting part moulds somewhat to the shape of the canal, while the maternal soft parts stretch and open out to make way for it, till finally it is expelled spontaneously, without serious damage to itself or to the mother. So long, then, as these three main factors are properly correlated, all goes well; but if their harmonious action be impaired, the normal mechanism of labor may be disturbed, and dystocia may be the result. The cause of the abnormal mechanism may be in any one of these three factors: the expelling force may be insufficient or excessive; the fœtus itself may be unusually large or small, may be in a faulty attitude or may present in an unfavorable position; the resistance of the maternal passages may be too great or too little. It is obvious, therefore, that in the management of a case of dystocia the recognition of the disturbing cause forms the basis of rational treatment, and should precede artificial assistance.

Dystocia may be most conveniently described, according to its causation, in three sections, as follows:

1. Anomalies of the expellant forces:
   (*a*) Excess—precipitate labor.
   (*b*) Deficiency—delayed labor—inertia uteri.
   (*c*) Spasm and irregularity—rigid os and cervix—tetanus uteri.
2. Anomalies of the passages:
   A. Hard parts—pelvic deformities.
      Influence on pregnancy and labor; frequency.

- Diagnosis—From previous history and physical appearance.
  - From mechanism of labor.
  - From head moulding.
  - From physical examination—pelvimetry.
    - (*a*) External measurements.
    - (*b*) Internal measurements.
- Classification:
- Pelves—Normally proportioned, but abnormal in size.
  - With anomalies of size, shape, inclination.
  - With minor developmental peculiarities.
  - Antero-posteriorly contracted.
  - Obliquely contracted.
  - Transversely contracted.
  - Compressed.
  - Spondylolisthetic.
  - Distorted by injury, tumors, anchylosis of joints.
  - With deformities due to spinal curvature.
- Individual forms particularly studied; relation to pregnancy an labor.

B. Soft parts:

- Uterus—Developmental anomalies.
  - Atresia of cervix.
  - Rigidity of cervix.
  - Impaction of cervix.
  - Malposition.
  - Sacculation.
  - New growths.
  - Stenosis and rigidity of vulva and vagina.
  - Hæmatoma vulvæ.
  - Œdema vulvæ.
  - Labial abscess and cysts.
  - Conditions of intestines.
  - Conditions of bladder.
  - Tumors and swellings of various tissues.

3. Anomalies of the fœtus:
   - Malposition of the head.
   - Occipito-posterior cases.
   - Malpresentations:
     - Face, brow, pelvic, transverse.
   - Prolapse of the limbs.
   - Anomalies of fœtal development:
     - Shortness of cord.
     - Unduly ossified skull.
     - Large size of fœtus.
     - Death of fœtus.
     - Enlargement of head or body by disease.
   - Plural births.
   - Monstrosities.

1. ANOMALIES OF THE EXPELLANT FORCES.

(*a*) Excess—Precipitate Labor.

When uterine action is excessive the resistance of the maternal passages may be overcome violently or rapidly, and then labor is said to be *precipitate*. The posture of the patient has an important influence upon the course and termination of such cases. In the dorsal or lateral position the pains are rarely strong enough to end labor so rapidly as to cause serious damage; but if the patient happens to be standing, walking, sitting, or squatting, a single violent pain may suffice to force the child completely through the passages. It may fall to the floor and be injured; the cord may be torn asunder and the placenta may be dragged from its attachments, or, remaining adherent, may pull the uterus along with it, causing inversion. If the patient happens to be sitting in a privy or water-closet, the child may fall into the cesspit or into the pan of the closet, and may perish before assistance can be procured. Not infrequently the mother faints from shock or loss of blood, or she may become so bewildered and frightened that she does not realize what has happened until it is too late to save her child. Such cases sometimes give rise to important medico-legal questions, especially when the child is illegitimate and a charge of infanticide is laid. While undoubtedly it must be admitted that such cases of sudden delivery do happen occasionally, *nevertheless it is very exceptional* for labor to be so rapid that the patient has no warning of what is about to take place and has no time to seek assistance. As a rule, the first stage of labor is more or less normal in such cases, and it is only in the second stage that precipitancy occurs. If the membranes are tough and the amniotic sac descends very low before rupturing, then the sudden gush of water may sweep the presenting part violently down upon the perineum, and delivery may be completed at a single pain. It does not always happen that precipitate labor follows excessive uterine action. If the maternal soft parts do not yield to the expellent forces, but are rather provoked thereby to greater resistance, labor may be delayed, and the uterus may become exhausted by fruitless efforts, or may even rupture. Under such circumstances the child will probably perish, the placenta being compressed and the fœtal circulation deranged by the prolonged uterine contraction.

Causes. The chief predisposing causes are (1) an undue excitabilty of the sensory nerves of the uterine muscle, which frequently exists in nervous excitable women,[1] and (2) previous inflammatory conditions of the uterus, such as an old endometritis. Debilitating conditions which relax the tone of the pelvic floor favor precipitate labor by diminishing the resistance which is to be overcome. Dysmenorrhœa, oblique presentations, pneumonia, and zymotic diseases (especially variola and scarlatina), may be mentioned also as predisposing causes. Fear, anxiety, and powerful emotions are said to increase the force of uterine contractions, but it is probable that their action is not constant, and that undue exertion on the part of the patient, such as walking, is usually the exciting cause.

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[1] Dr. Routh recently reported to the London Obstetrical Society a case of labor in a woman suffering from complete paraplegia (traumatic) below the level of the sixth dorsal vertebra. The only sensation which the patient felt during a pain was a tight feeling at the epigastrium, causing her to hold her breath. Dr. Routh concludes that the act of parturition is partly automatic and partly reflex, and thinks that direct communication by means of the sympathetic between the uterus and the lumbar enlargement is essential to the regular and co-ordinate contraction and retraction of the uterus during labor. If this view be correct, it is obvious how powerfully uterine action may be influenced by causes acting through the sympathetic, and how frequently the true cause of abnormal uterine action may be found in derangements of the nervous system.

Sequelæ. The most important immediate consequences of precipitate labor are lacerations of the vagina, vulva, and perineum, partial or complete separation of the placenta, hemorrhage, inversion of the uterus, and delayed expulsion of the placenta. Violent contraction of the uterine muscle is apt to be followed by relaxation and atony, and hemorrhage may result. In the puerperium also many troubles may arise, such as œdema, retention of urine, hemorrhage, and septicæmia. Violent straining efforts in rare cases have produced emphysema of the throat, neck, and chest from slight lesions of the trachea or bronchi; but this usually disappears in a few days without treatment.

The fœtal mortality is greater than in normal labor. The child's head may be injured by being driven forcibly against the promontory of the sacrum, and the cranial bones may be furrowed or even fractured. The child may be asphyxiated by undue compression of the fœtal head or of the cord or placental site. It may be injured by falling violently upon the floor, or it may perish by dropping into a cesspit or water-closet.

Treatment. If a previous labor has been precipitate, or if the uterine action is manifestly excessive or violent, the patient should not be allowed to stand or walk about, or to sit upon the closet, especially during the second stage of labor, but should be kept in bed and made to lie on her side. To moderate the violence of the pains, a dose of chloral (grs. xx to xxx) may be given, or a hypodermic injection of morphia (gr. $\frac{1}{4}$), or a few whiffs of chloroform may be administered at the beginning of each pain. The patient should be made to pant during her pains, and should not be allowed to hold her breath or bear down. Some authorities advise rupturing the membranes before the os is fully dilated. When the pains of the first stage cause great suffering, some writers recommend painting the cervix with a solution of cocaine (4–10 per cent.). During delivery care should be taken to protect the perineum, the head being held back and prevented from descending too rapidly. Some authorities advise the application of forceps in order to give greater control over the head and prevent its too rapid descent and expulsion. Chloroform is invaluable at this stage. Great care should be taken in the management of the third stage of labor; plenty of time should be given for the placenta to separate, and the uterus should be kept under control for some time after the placenta has been expelled, in order to guard against subsequent relaxation. If the uterus does not contract well, or if it shows a tendency to relax, a copious hot intra-uterine douche should be given, followed by a hypodermic injection of ergot. The physician should not leave his patient until he is satisfied that the uterus is well contracted, and that there is no further danger of hemorrhage.

(*b*) DEFICIENCY—DELAYED LABOR—INERTIA UTERI.

When the uterine action is insufficient to overcome the resistance of the parturient canal labor is delayed, and the pains are said to be *weak*.

The weakness of labor-pains is relative. Pains which would be strong enough for the first stage may be inadequate for the second stage. Pains which would be normal and efficient if the resistance were slight, may be inadequate, and, therefore, abnormal when the resistance is great. The true test of the weakness and inefficiency of labor-pains on the one hand, or of their strength and efficiency on the other, is the advance of labor; whenever they are too short or too feeble to secure the normal progress of labor, they are *weak*. Mere sluggishness of uterine action, however, is not to be confounded with weakness. Sluggish pains recur at abnormally long intervals, yet they may be strong and efficient nevertheless. In estimating the character of the pains three qualities should be considered: (1) their *length*, (2) *strength*, and (3) their *frequency*.

Causes. The cause of deficient uterine action may be either in the uterus itself or in some other organ. There may be some congenital malformation, as the uterus bicornis, or the uterine muscle may have been weakened by previous inflammation, by menorrhagia, by repeated abortions, or by too frequent childbearing. Its fibres may be so stretched that they cannot contract efficiently, as in multiple gestation or hydramnios. There may be malpresentation, or too early rupture of the membranes, or a faulty attachment of the placenta, as in placenta prævia. New growths in the uterine wall, as myomata; displacements of the uterus, as prolapsus; or deviations in its axis, may all cause inertia. Uterine weakness in the third stage frequently occurs in precipitate labor; and, on the other hand, it is very likely to follow a prolonged and painful first and second stage.

Very often the cause of weak uterine action must be sought elsewhere. A distended bladder or rectum, a dilated stomach or intestine, may so alter the position and axis of the uterus as to make its contractions painful and inefficient. Sometimes the patient does not use her abdominal muscles properly and the uterus is unable to overcome the resistance of the parturient canal unaided. The physical strength of a patient is not always a correct index of the expulsive power of her uterus or of the ease of her labor; much depends upon her fortitude and pluck and the intelligent use of her voluntary muscles. Weak, delicate women (*e. g.*, consumptives) frequently have strong pains and easy labors, while robust, powerful women are often disappointing by reason of their weak pains and tedious labors.

Long residence in tropical climates tends to cause uterine inertia. European women in India suffer from menorrhagia, uterine inertia, and post-partum hemórrhage. A luxurious and enervating life predisposes to inertia. Age has also a certain influence; in young primiparæ the pains are apt to be imperfect and irregular. Mental conditions, such as grief, excitement, and depression, often weaken the force of the uterine contractions.

Symptoms. The symptoms depend upon the stage of labor. If the membranes are unruptured and weakness manifests itself during the first stage, the pains are short, the cervix dilates very slowly, the bag of membranes does not feel tense or press down into the cervix during a contraction, the presenting part descends but slightly with each pain, and may be pushed back easily with the examining finger. If the membranes rupture early, the presenting part advances slowly or not at all. The chief indication, therefore, of deficient uterine action in the first stage is delay or arrest of labor from imperfect dilatation of the cervix. Constitutional symptoms (elevation of temperature, pulse, and respiration) do not usually appear unless the delay is very prolonged. In the second stage the symptoms are chiefly those of pressure. If the presenting part is arrested but not impacted, the pressure symptoms may not be pronounced; but if impaction occur, the vagina soon becomes hot, dry, swollen, and tender, the external genitals swell, and there may be cramps in the legs and cutting pains in the back, loins, and abdomen. After a time constitutional symptoms develop, the pulse, temperature, and respirations rise, the tongue becomes furred and dry, nausea and vomiting may occur, the countenance becomes anxious, the face swollen, the patient restless, and if she be not promptly relieved, low muttering delirium supervenes and death ensues with symptoms of profound exhaustion. It is remarkable with what rapidity nervous exhaustion takes place when strong uterine contractions are unable to overcome the resistance of the birth-canal. The fœtus, too, shows signs of distress; its movements become violent, the fœtal heart-beat increases and then rapidly decreases in frequency, and finally death occurs from asphyxia.

Sometimes the uterine weakness is not general, but is confined to the fundus, the placental site, or a portion of the anterior or posterior wall. If the weakness is in the fundus, labor is usually slow; if in the anterior or posterior wall, the weakened portion bulges, and rupture may take place; if near the placental site, there may be deficient contraction and retraction during the third stage, and the placenta may be retained, or hemorrhage may occur.

Care should be taken to distinguish between a powerless uterus and a tetanically contracted uterus. In both cases labor is arrested or delayed, but in the latter case the condition is more serious. The uterus retracting about the fœtus becomes unevenly pressed about the limbs and body of the child, and certain portions of its walls becoming intensely congested and thinned out may rupture or slough subsequently. The tetanic uterus is known by its constantly hard and board-like feel; such a condition should not be ascribed to inertia uteri.

The effects of deficient uterine action upon the third stage of labor are important. The uterus may have acted well during the first and second stages, but may have become so exhausted that it cannot contract and retract satisfactorily during the third stage. Occasionally the weakness in the third stage is only the continuation of weakness in the first and second stages. Good uterine contraction is essential to the proper separation and expulsion of the placenta; hence when the pains are infrequent and weak, the placenta is apt to remain partially or wholly adherent, and in the former case hemorrhage occurs. After separation has taken place a weak uterus may be unable to expel the placenta and membranes from its cavity, and even after they have come away it may tend to relax and permit free hemorrhage or the formation of a large clot.

Diagnosis. The diagnosis is made by making a vaginal examination during a pain and by palpating the abdomen externally. In the first stage of labor, if the bag of membranes does not become tense, and the presenting part does not descend during a pain, if the cervix does not dilate and labor does not advance, the uterine action is inefficient. If in the second stage the presenting part becomes arrested or impacted, if the maternal passages become dry, swollen, and tender, and especially if constitutional symptoms supervene, it is safe to conclude that the expellant forces are unable to overcome the resistance of the parturient canal. By palpating the abdomen it may be ascertained how frequent and strong the pains are, and whether there is any deviation in the axis of the uterus, or whether a distended bladder is interfering with uterine action. In doubtful cases the condition of the thoracic and abdominal viscera should be ascertained.

Prognosis. The prognosis depends upon the stage of labor, the degree of weakness and its cause. In the first stage, if the membranes are unruptured there is usually very little danger for either mother or child; but if the membranes have been long ruptured the life of the fœtus may be imperilled. In the second stage there may be danger for mother and child if labor be too much prolonged. According to some authorities, delivery cannot be delayed safely beyond seven or eight hours after rupture of the membranes. No such hard-and-fast rule can be laid down, since in some cases a long delay may be harmless, while in others a comparatively short delay may entail serious consequences. The condition of the mother and child should be watched carefully in all cases of delayed labor. A slowing fœtal heart foreshadows danger to the child, while local œdema and a rising pulse and temperature are maternal danger-signals which should not be disregarded. As a general rule, the longer the delay the worse is the prognosis for both mother and child. The prognosis is usually better in multiparæ than in primiparæ, and better in partial than in total uterine weakness. Atony of the placental site and general atony of the uterus in the third stage are serious conditions, for they may lead to violent or uncontrollable hemorrhage.

Treatment. The treatment varies according to the stage of labor, the cause of inertia and its extent. The room should be kept cool, since heat favors uterine weakness. Visitors should be excluded and the patient kept free from excitement. If the cause of inertia can be ascertained, it should be removed if possible; a distended bladder or rectum should be emptied, a deflected uterine axis straightened. In the first stage of labor, if the membranes are unruptured and the patient is exhausted, no attempt should be made to excite uterine action, but rest and sleep should be secured by means of chloral, grs. xx, repeated if necessary, or a hypodermic of morphia, gr. $\frac{1}{8}$ to $\frac{1}{4}$. Chloral is generally preferable to morphia, because it does not arrest the progress of labor. Opium is apt to stop or weaken the pains, and should be used only when the suffering is too great to be relieved by chloral. Chloral and opium may be combined sometimes with advantage; a very good draught is:

Chloral. hydrat.	grs xx;
Lip. op. sed. (Battley)	♏x;
Syr. aurant.	ʒij;
Aq. ad.	℥j.—M.

Antipyrine is sometimes useful when the pain is mainly neuralgic in character. At the same time broth, hot milk, gruel, or some other nutritious assimilable food should be given to maintain the patient's strength. After a few hours' rest strong uterine action generally sets in and labor proceeds normally. If the membranes have been long ruptured and further delay seems inadvisable or dangerous, coffee, broth, or eggnog may be administered, and attempts made to increase the power of uterine contractions. Quinine is sometimes of great value, but it must be given in large doses to be effectual—not less than fifteen grains should be given in two powders or cachets, within the space of half an hour. Strychnine hypodermically (gr. $\frac{1}{30}$ to $\frac{1}{20}$) is very often useful, especially if the heart's action is weak. Locally, a copious hot vaginal douche (3 to 4 quarts of boiled water at a temperature of 105° to 110° F.) may be given every hour or two. Good results have been reported from the introduction of a soft bougie into the uterus, as in Krause's method of inducing labor. On the Continent a favorite method is to pass a rubber bag (colpeurynter) into the vagina and then distend it slowly with water or air. The Champetier de Ribes bag, introduced into the uterus, is very useful for this purpose, and sometimes changes the character of the pains remarkably. Hot fomentations to the fundus are employed sometimes to excite or increase uterine action.

It is the custom with some practitioners to rupture the membranes early in the first stages of the labor for the purpose of hastening delivery. Such practice is not only harmful, but actually tends to prolong rather than shorten labor, especially when uterine action inclines to be weak. As a rule, the membranes should be preserved intact as long as possible, or at least until dilatation of the cervix is nearly complete. When, however, the uterus is overdistended, as in hydramnios, and the contractions are weakened thereby, it is advisable to rupture the membranes, even though the os is only partially dilated, in order that the tension may be relieved and uterine action stimulated.

In the second stage, when further delay is likely to be injurious, labor should be terminated as soon as possible. When delay is due to weak muscular action, or to some deviation in the uterine axis, a change of posture often produces the happiest results. If there is excessive right obliquity the patient should be made to lie on the left side; if there is anteversion from lax abdominal walls, a binder should be applied and the patient should lie on the back. Sometimes uterine action may be stimulated very satisfactorily by changing the patient from the lateral to the dorsal position and raising the shoulders till she is sitting almost upright, or by causing her to get out of bed and walk about, or stand or sit for a time.

Manual pressure applied to the fundus through the abdominal wall is a valuable means of intensifying feeble pains and prolonging their efficiency. The patient should lie in the dorsal position, and pressure should be made during a pain in the axis of the brim, much in the same way as in the Credé method of expressing the placenta. Schmidt, of Moscow, places the patient in the extreme lithotomy position during this manipulation. Roughness should be avoided, and care should be taken not to compress or injure the ovaries.

Recently the use of ergot has been warmly recommended to increase the force of the pains in the second stage of labor. It is possible that such practice may be serviceable in exceptional cases, but ergot is more less dangerous before the birth of the child, and its use cannot be commended unless for some special indication. It should be given utiously, a dose of ♏x to xv of the fluid extract hourly for two or hree hours usually being sufficient.

Operative interference (forceps, version, etc.) may be required to terminate labor. No doubt much harm may be done by the rash and indisriminate use of forceps; but it is possible to err in the other extreme; indeed, it is quite likely that more lives have been lost and more serious injury has been done by deferring the use of forceps too long in lingering labor than by operating too early.

(c) SPASM AND IRREGULARITY—RIGID OS AND CERVIX—TETANUS UTERI.

The uterine contractions may be abnormally painful, and whether strong or weak they may be faulty in direction, duration, or effect. Such spasmodic contractions may be general or partial, and although lonic at first, they soon tend to become tonic. The so-called tetanus uteri is a condition of general tonic contraction.

Causes. A uterus rendered irritable by previous endometritis may take n spasmodic action after premature rupture of the membranes, especilly if there is malpresentation or impaction, or if there is undue resistance, as in pelvic deformity. The tendency to spasmodic action is increased by too early use of ergot, by repeated vaginal examinations, or by rough manipulations, as in attempts to dilate the cervix forcibly or to deliver by forceps or version through a partially dilated cervix. In the third stage of labor, attempts to deliver the placenta by traction upon the cord may cause a similar condition. When the spasmodic action does not involve the whole uterus the structures most commonly affected are the circular fibres around the external and internal os and the orifices of the Fallopain tubes, and then a sort of spasmodic stricture is produced. Stricture and tetanus uteri differ only in degree; the former readily passes into the latter, followed by marked constitutional disturbance, if the spasm be not promptly relieved. Spasmodic contraction of the internal os may delay labor; a similar effect may be produced by the undue contraction of Bandl's ring (contraction-ring), commonly called *hour-glass contraction* of the uterus.[1] The disturbances in the course of labor caused by this spasmodic constriction vary according to the position of the fœtus in utero, the degree of uterine activity, and the amount of constriction caused by the ring. The constricting fibres prevent the descent of the fœtal parts which are above hem into the lower uterine segment, and this holding back of the fœtus revents the advance of the parts which are already below the ring. As result of this obstacle to descent the progress of labor is retarded or rrested altogether.

Diagnosis. If the fibres of the os and cervix are chiefly involved, the is sensitive to touch and feels to the examining finger like a tensely retched ring; it may remain unchanged for hours in spite of strong

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[1] Some writers maintain that hour-glass contraction is caused by the spasmodic contraction of a band of circular fibres in the uterine body above the level of Bandl's ring.

uterine action. The rigid os caused by spasmodic action is sometimes called the *whip-cord* os; it is usually found in nervous women. The *œdematous* os is caused by prolonged pressure of the hard head against an imperfectly dilated os. It occurs generally after too early rupture of the membranes. These forms of rigid os must be distinguished from the *cartilaginous* os, which is caused by an excessive amount of fibrous tissue in the cervix and os. This is found in women with masculine pelves, or with procidentia uteri, friction causing an increase of fibrous tissue. The lower uterine segment and the cervix may thin out and become stretched over the presenting part, yet the os does not yield. When there is general tonic spasm the uterus does not relax, but remains in a state of continuous contraction, and through the abdominal wall feels as hard as a board. If it becomes moulded about the head, elbows, and knees of the fœtus, and assumes an irregular contour, the fœtus is held gripped in the spasmodic clutch of the uterine fibres, and labor is arrested.

Prognosis. The prognosis is more favorable for mother and child in stricture than in tetanus uteri. In the latter the placental circulation is seriously disturbed and the child is apt to perish soon from asphyxia. After a time the uterus becomes so unevenly thinned and stretched that it is likely to rupture or to be injured and lacerated during attempts to effect delivery.

Treatment. Whenever spasmodic action of the uterus exists, even in slight degree, frequent vaginal examinations and rough manipulations should be avoided and ergot should not be given. In mild cases and in the early stages generally, spasm may be relieved by the internal administration of chloral (gr. xx, not more than three doses being given), or by a hypodermic injection of morphia. Locally much relief is obtained by a hot sitz-bath and copious hot vaginal douches. If these measures fail, chloroform should be administered at once and continued till spasm is relieved. Unless in cases of extreme urgency, delivery by forceps or version should not be attempted until the os has become well dilated and uterine spasm has relaxed, otherwise so much force may be required to effect delivery that serious injury may be done to both mother and child. If the os is rigid and operation is urgently demanded, manual dilatation under chloroform should be tried, or a Champetier de Ribes bag may be used; if these measures fail, multiple incisions should be made in the os. When the child is dead, or cannot be delivered alive, embryotomy should be performed. In extreme cases Cæsarean section may be required. Under no circumstances is it wise to resort to *accouchement forcé* in such cases. Under proper management, tetanus uteri should not be allowed to develop. Even after delivery has been effected all danger is not over: the placenta may be retained and the patient may require to be deeply anæsthetized before it can be extracted; severe bruising and laceration may have taken place, and the patient may suffer subsequently from pressure-fistulæ, pelvic exudations and inflammations, or from septicæmia.

Some obstetricians report considerable success in the treatment of rigid os with the use of cocaine and atropine. The os is painted with a 2–4 per cent. solution of cocaine, or a cocaine suppository is placed in the cervial canal, or a hypodermic injection of atropine (gr. $\frac{1}{40}$) is made into the rigid cervix.

Some writers describe a variety of cervical spasm in which the cervix contracts tightly about the neck of the child after the head has passed. This condition, however, seems to be an elastic rather than a spasmodic contraction of the cervix, which continues if the shoulders are very large and the uterus is lacking in expulsive power. In most cases it may be overcome readily by stretching the contracting ring with the fingers while strong downward pressure is made upon the fundus.

CHAPTER XX.

ANOMALIES OF THE MECHANISM.—CONTINUED.

2. ANOMALIES OF THE PASSAGES.

A. Hard Parts—Pelvic Deformities.

UNDER this heading are included all variations from the normal type of bony pelvis. The great majority of these anomalies are of the nature of contractions, which make labor a difficult or dangerous process for the mother, the child, or for both, and which generally call for some form of artificial delivery. The pelvis may be contracted in any or all of its diameters, but as the most serious forms are those in which the brim is affected, it is very common to use the term "contracted" as referring to these alone. In such a sense it is employed in this chapter, unless otherwise indicated.

Contracted pelves may influence the position of the uterus during pregnancy. Thus, in the early months marked contraction of the pelvic inlet may cause the growing organ to become retroverted, a condition which may be followed by incarceration in the pelvis. In the late months the uterus is higher than normal, the fœtal head not being able to sink within the pelvic cavity. The abdomen is rendered unduly prominent; pendulous belly is often marked; the long axis of the uterus being directed forward or to one or the other side.

Contracted pelves also influence the presentation and position of the fœtus, malpresentations and malpositions being about three times as frequent as in normal pelves. Thus a vertex presentation may be changed to a brow, face, or transverse. When the breech presents the knees or feet are apt to descend. The cord is also apt to prolapse into the lower pole of the uterus. These malconditions are favored by multiparity, owing to the increased relaxation of the uterine and abdominal walls.

But it is in labor that the most marked effects of contracted pelves are seen. At the beginning of the first stage the presenting part is higher than in the normal condition, and it does not fit well into the lower pole of the uterus. The cervix and lower uterine segment hang loosely at or above the brim. The liquor amnii is driven downward, and there is a tendency to the protrusion of the bag of membranes through the slowly dilating cervix as a sausage-shaped mass. Frequently the bag ruptures early, the uterus being drained of the liquor amnii. If the contraction be not too great to allow the fœtus to be born, labor may continue, being prolonged and painful, the cervix dilating slowly, and the fœtus born dead, the head being much altered by moulding, sometimes with fractures of its bones. If the labor be too prolonged in such a case, or if the contraction be too great to allow the fœtus to descend at all, the mother may become completely exhausted, and labor may cease for a time, or excessive thinning and stretching of the lower uterine segment may continue until it ruptures, alone or along with the cervix and vaginal wall; sometimes the uterus may be torn from the vagina.

In any case there is apt to be bruising of the soft parts from prolonged pressure of the head, and this may be followed by sloughing.

It is thus evident that the risks to the mother are varied and serious. The life of the fœtus is also greatly endangered, owing to pressure on the head, prolapse of the cord, delay in delivery, or to complications arising from operative measures necessary to the extraction of the fœtus.

Frequency. Deformed pelves are generally considered to be much more frequent in the Old World than in the New. In the light of recent work it is doubtful if this widely held view is correct. In both continents it is very difficult to get accurate data regarding the frequency of their occurrence. This is due to the fact that there is an absence of a common understanding regarding the definition of deformity. Thus, both in Europe and America, many observers have neglected minor degrees of contraction, considering only those capable of causing serious troubles. Statistics vary also according to the expertness or fitness of different observers in recognizing deformities.

In this connection the recent work of Williams and Dobbin, of Johns Hopkins, is worthy of the most careful study. Their observations are a direct challenge to those who hold the common belief regarding the infrequency of pelvic deformity in America. It is their view that deformities are considered rare only because they are not systematically looked for by the routine examination and measurement of all pregnant and parturient women. In 1000 cases of labor observed by them there were 131 contracted pelves, or 13.10 per cent. Of this number, 46, or 35.11 per cent., were of such a degree as to necessitate operative delivery. It is interesting to compare these figures with those of Winckel, who states that 10 to 15 per cent. of all childbearing German women have contracted pelves, but that only in 5 per cent. is the contraction serious enough to be noticed. The percentage of operative frequency in Europe is variously noted by different workers. Knapp puts it at 61 per cent.; Heinsius, 56.84 per cent.; Ludwig and Savor, 45.6 per cent.; Bosmann, 24.5 per cent.; Franke, 20.5 per cent. In America the largest percentage is that of Flint, of New York, viz., 46. The well-known statistics of Reynolds, of Boston, are not at all reliable with regard to the frequency of all degrees of pelvic deformity, for, of the 2127 cases studied by him, measurements were made practically only in those in whom operative delivery was carried out.

Williams and Dobbin have shown that such a method of inquiry can result only in the non-recognition of a considerable number of deformities. This was demonstrated by their careful study of negro women. They found that pelvic contractions were much more frequent among these than among white women. Yet, on account of the small and easily moulded fœtal head, the degree of contraction is rarely sufficient to obstruct labor to a serious degree. Therefore, if only those cases were considered in which operative interference is necessary, a considerable number of deviations from the normal would be overlooked.

The most frequent contractions met with in practice are the following:

1. The justo-minor or universally contracted pelvis.
2. The flat non-rickety and rickety.

3. The funnel-shaped pelvis.
4. The pelvis altered by various spinal deformities.

Of these, perhaps the most common are the universally contracted and the flat.

Diagnosis of Anomalies of the Hard Pelvis in General. Three lines of investigation open to the obstetrician for determining the condition of a woman's pelvis:

1. A careful study of the history of her previous health and labors, and a thorough examination of her physical condition;
2. The study of the mechanism of labor itself;
3. Evidence may be gained from the condition of the child's head after delivery.

The latter two subjects will be considered with the individual pelves. In this section attention will be directed alone to the first heading.

In examining a woman her previous history should be inquired into. If she had suffered from rickets in childhood there would be a history of late dentition, irritability, bad digestion, restlessness and perspiration at night, late closure of the anterior fontanelle. She may have had bending of the long bones or spine, square head, pigeon-breast, rosary ribs, enlarged ends of long bones, and she may be of short stature.

Various deformities of the pelvis may be associated with rickets—*e. g.*, the *rachitic generally contracted*, the *rachitic infantile*, the *rachitic flat*, the *scolio-rachitic*, the *kypho-scolio-rachitic*, and the *rachitic rostrate* (*pseudo-malacosteon rachitic*).

The patient may have suffered from *osteomalacia*, in which case she would probably give a history of poverty, overwork, and exposure to cold and wet under unfavorable conditions of life, the disease having begun in a former pregnancy or lactation-period, with dull or aching pains in the limbs, back, and pelvis, worse on movement.

Tuberculosis may have affected her in one or other lower extremity, in the hip, or sacro-iliac joint, leading to a simple oblique contraction of the pelvis; or it may have occurred in the spine, giving rise to kyphosis, which secondarily may affect the pelvis.

The patient may have suffered from accident to a limb, resulting in shortening, dislocation, weakening, or amputation, secondarily leading to a single oblique contraction of the pelvis; or injury may have dislocated the lumbar vertebræ from the sacrum, causing the condition of *spondylolisthesis*.

Possibly the patient may give a history of a weakly early life, associated, however, with no special disease. Such a condition may be associated with a flattening of the pelvis or with some maldevelopment. Or she may have been born with a congenital dislocation of one or both hips, or with spondylolisthesis.

But the most satisfactory information is derived from the physical examination of the pelvis—pelvimetry. A series of measurements are to be made in the following systematic manner.

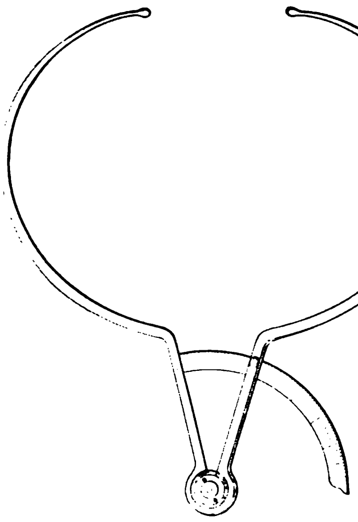
(*a.*) External Measurements.

1. **Antero-posterior.** An important antero-posterior measurement is that known as the "*External Conjugate of Baudelocque.*" To determine this, the patient is placed on her side, her hips being carefully exposed

and the clothes tucked out of the way. The physician stands behind the patient, looking toward her head. He then takes a pair of calipers, the so-called pelvimeter, and holds a rod in each hand, the tip of the index-finger being on each knob. The knob of one rod is placed in the depression just below the spine of the last lumbar vertebra, and the other on the skin of the mons veneris in front of the upper part of the symphysis. The rods are then fixed in position, a screw being turned by an assistant, and the measurement is read on the scale attached to the instrument.

To determine the length of the conjugata vera, it is necessary to subtract that which represents bones and soft tissues. This varies greatly in different cases and cannot be accurately determined. In 30 cases in which Litzmann measured the external conjugate during life and the true conjugate after death there was an average difference between the two of 9.5 cm. (3¾ in.); in the whole series there was a range from 7 cm. (2¾ in.) to 12.5 cm. (4$\frac{15}{16}$ in.). In some cases the conjugate of Baudelocque indicates contraction of the pelvis with certainty; in others, non-contraction with equal certainty. There are, however, many cases in which it cannot be relied on. Jewett states that with an external conjugate at or below 6 in. (15.2 cm.), or even below 6¼ in. (15.8 cm.), the pelvis is invariably contracted; at or above 8 in. (20.3 cm.) the pelvis is almost surely ample; between 6¼ and 8 in. the length of the vera is doubtful, and must be settled by other measurements.

FIG. 251.



Baudelocque's pelvimeter.

There is another manner in which the vera may sometimes be made out in a thin non-pregnant woman, or in a pregnant woman whose uterus has not risen above the brim, viz., by placing the hand on the hypogastrium and pressing the abdominal wall with the tips of the straightened fingers against the promontory; the thickness of the abdominal wall and pubes can be fairly correctly estimated and allowed for.

2. **Transverse.** It is impossible to estimate the transverse diameter of the true pelvis accurately. The following measurements are usually made:

(*a*) Interspinous; between the anterior superior iliac spines. In normal cases this varies from 9½ to 10½ in. (24.1 to 26.7 cm.).

(*b*) Intercristal; between the widest parts of the iliac crests. In normal cases this varies from 10½ to 11½ in. (26.7 to 29.1 cm.).

In the normal pelvis the average difference between (*a*) and (*b*) is 1 in.

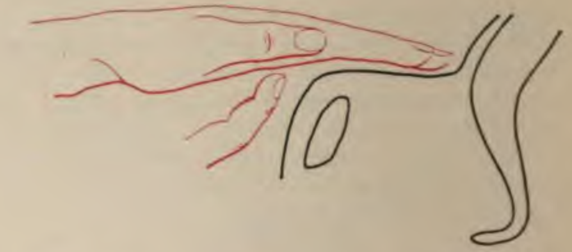
(*c*) Between the posterior superior iliac spines. This measures normally about 3⅞ in. (9.8 cm.).

(*d*) Between the great trochanters. This measurement is not very reliable, owing to variations in the head, neck, and trochanter of the femur. If, however, it be less than 11½ inches, transverse contraction of the pelvis may be suspected.

If all of these measurements are considerably less than the normal, transverse contraction of the pelvis is certain.

3. **Oblique.** The measurements made for the purpose of determining oblique contractions of the pelvis are given on page 438.

FIG. 252.



Measuring the conjugate in a non-pregnant rachitic woman by external application of the hand

(*b*.) Internal Measurements.

For the purpose of determining the size of the pelvic canal the finger alone are sufficient.

By a careful vaginal examination the wall of the canal may be prett thoroughly examined. A good general idea of the capacity of the cana may be made out, projections can be felt, anchylosis of the coccyx can b determined, and the size of the outlet estimated. The height of th symphysis can also be made out. Certain special measurements mus however, be made:

1. *The diagonal conjugate—i. e.*, from the promontory to the subpub ligament. In determining this the patient should be placed in the lit otomy position, and the first two fingers, extended, should be passed the vagina until the tip of the second finger touches the promontor

The radial side of the hand is then raised until it presses against the subpubic ligament, and a mark is made at this point on the hand, which is then withdrawn. With a pelvimeter the distance between this mark and the tip of the second finger is then taken. This is the length of the diagonal conjugate. In the normal pelvis it is ½ to ⅔ inch greater than the true conjugate of the brim. The difference between these diameters varies in different pelves, according to the height of the symphysis, the height of the promontory, and the angle between the vertical axis of the symphysis and the true conjugate.

Thus, in the rickety flat pelvis, where the height of the symphysis is greater than normal, and the angle between its axis and the vera is also greater, the difference between the diameters is greater than in the normal pelvis.

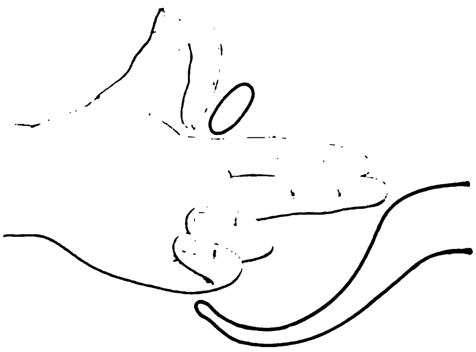
When the height of the symphysis is more than 1½ in., slightly more than ⅔ in. should be deducted from the diagonal conjugate.

In the great majority of cases a diagonal conjugate of less than 4½ in. (11.5 cm.) indicates antero-posterior pelvic contraction.

2. *Löhlein's measurement*, from the subpubic ligament to the upper anterior angle of the great sacro-sciatic notch. This is said to be normally ¾ in. (2 cm.) less than the transverse diameter of the brim.

3. *Hirst's measurements*, from the promontory to the upper outer edge of the symphysis. This is taken with a special pelvimeter consisting of a long straight rod which is passed up the vagina to touch the promontory, and a short curved rod, which touches the front of the symphysis. When the instrument is in position its rods are tightened and then removed, the distance between the points of the rods being measured. The thickness of the upper parts of the symphysis is then measured with a small pair of calipers and is subtracted from the first obtained length, in order to give the length of the true conjugate.

FIG. 253.



Internal pelvimetry. Measuring the diagonal conjugate with the hands.

In measuring the diagonal conjugate with the fingers, there may be difficulty in reaching the promontory if the patient strains much, if the perineum is rigid, if the pelvis is very deep, or the promontory high or far back. The condition of double promontory, viz., that in which the junction of the first and second sacral vertebræ projects forward, like that between the last lumbar and first sacral, may exist and lead to an error in estimation; the point nearest the symphysis should always be chosen. In these conditions of difficulty the employment of general anæsthesia is of great value.

It is of great importance, also, to measure the conjugate and transverse diameters of the outlet. For this purpose special instruments are employed by some. but exact information can be obtained with the fingers and calipers.

Careful routine pelvimetry should be carried out by all who practise obstetrics. In this way alone it is possible to work with scientific accuracy and to avoid those risks to mother and child which are certain to attend him who establishes a diagnosis after the complications of a dystocic labor have begun.

Classification.

Various classifications are employed in different countries. It is needless for the student to study the relative merits of these. It is best to select one as his basis of study, realizing that no system can satisfy all requirements of scientific completeness. The following plan is recommended:

I. Pelves normally proportioned but abnormal in size:
  1. Uniformly enlarged (*æquabiliter justo-major*).
  2. Uniformly contracted (*æquabiliter justo-minor*).

II. Pelves with anomalies of size, shape, inclination, or combinations of these:
  1. Those with minor developmental peculiarities: (*a*) Masculine (*b*) shallow, (*c*) deep, (*d*) funnel-shaped.
  2. Antero-posteriorly contracted:
     Flat, non-rachitic.
     Flat, rachitic.
  3. Obliquely contracted:
     By imperfect development of one sacral ala (Naegele pelvis).
     By imperfect or abolished use of one limb.
     By lateral spinal curvature.
  4. Transversely contracted:
     By imperfect development of both sacral alæ (Robert pelvis).
     By kyphosis of the spine.
  5. Compressed pelvis:
     Malacosteon.
     Pseudo-malacosteon rachitic.
  6. Spondylolisthetic.
  7. Pelvis distorted by injury, tumors, anchylosis of joints.
  8. Deformity due to spinal curvature:
     (*a*) Kyphotic.
     (*b*) Scoliotic.
     (*c*) Kyphoscoliotic.
     (*d*) Lordosis.

Individual Forms.

I. Pelves Normally Proportioned, but Abnormal in Size.

Uniformly Enlarged Pelvis (*æquabiliter justo-major*). This pelvis has all the characters of a normal pelvis, except that all the measurements are proportionately increased in size. They are found in large, though not necessarily in tall, women.

INFLUENCE ON PREGNANCY AND LABOR. In pregnancy the uterus tends to remain longer in the pelvis than in a normal condition, and, consequently, to disturb the bladder and rectal functions. It is generally believed that the labor is apt to be a hurried one. There is a greater tendency to post-partum hemorrhage, as Webster has shown, owing to the imperfect filling of the pelvis by the uterus.

FIG. 254.

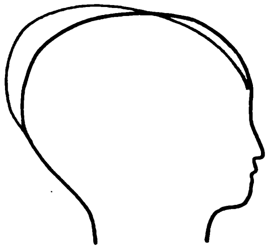
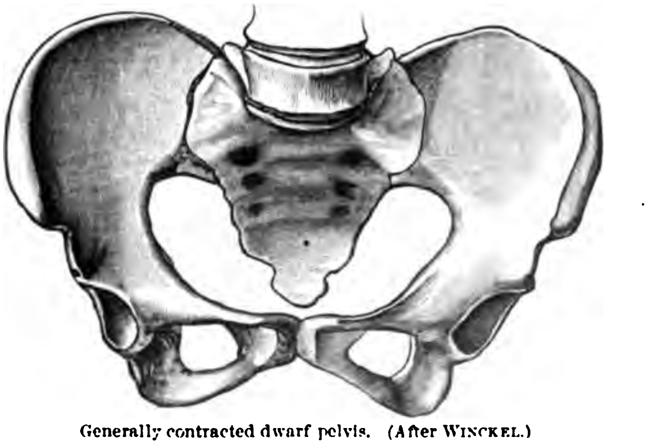


Diagram showing head unmoulded and moulded by labor in normal vertex case.
Black, unmoulded.
Red, moulded.

Uniformly Contracted Pelvis (*æquabiliter justo-minor*). The most common form has the characters of a normal female pelvis save that all the measurements are proportionately diminished. It is found in women slightly undersized, but may also occur in persons of ordinary height, or even in tall women.

Two other varieties are described by many authors, viz., the *infantile* form, in which, with the small size of the bones, many of the features of the early pelvis are retained, and the *dwarf* form, in which the bones are slender and fragile, the cartilaginous junctions between the constituents of the *ossa innominata* being retained.

FIG. 255.



Generally contracted dwarf pelvis. (After WINCKEL.)

ETIOLOGY. The causation of this condition is not well known. In some cases it is due to imperfect development—*e. g.*, in dwarfs. In other cases it may be due to unfavorable hygienic surroundings and bad nutrition in early life.

DIAGNOSIS. The diagnosis is based on careful pelvimetry. The justo-minor pelvis may easily be mistaken for a rachitic pelvis.

FIG. 256.

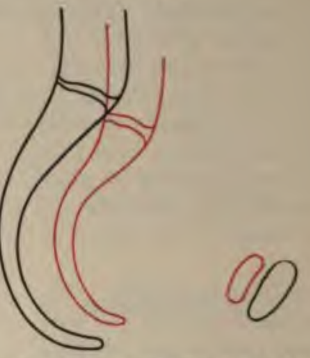
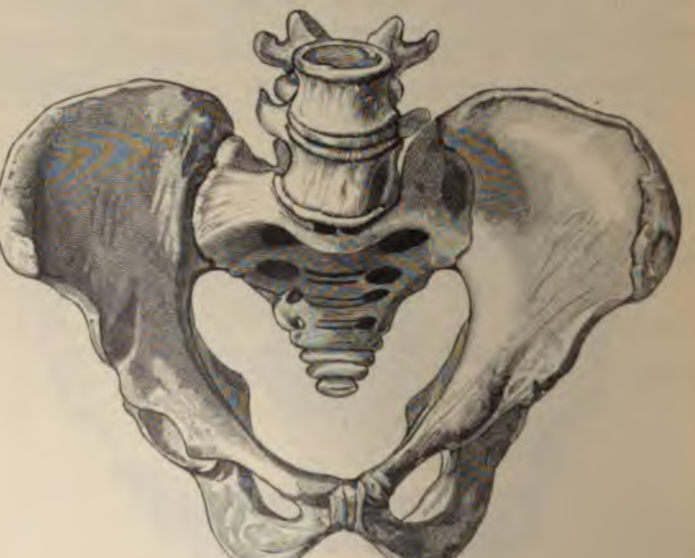


Diagram showing difference between normal and justo-minor pelvis on vertical mesial section. Black, normal. Red, justo-minor.

INFLUENCE ON LABOR. If the contraction is not too great to allow the fœtus to be born, the labor takes place by a definite mechanism which resembles that in a normal pelvis, the flexion, however, being much mor marked. In the normal pelvis flexion occurs so that the suboccipit bregmatic diameter, drawn to the anterior angle of the bregma, com

FIG. 257.



Infantile pelvis. (After AHLFIELD.)

into relation with the brim. In the justo-minor pelvis a shorter posterior suboccipito-bregmatic diameter comes into relation with the brim as a result of the increased flexion, depending upon the increased resistance with which the head meets. On examination, during labor, the tip of the occiput or even the external occipital protuberance (inion) may be felt in the centre of the canal.

FIG. 258.

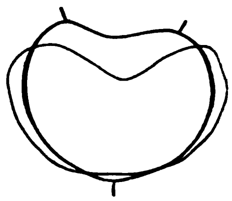


Diagram showing outline of brim of normal and of justo-minor pelvis.
Black, normal.
Red, justo-minor pelvis.

After flexion, internal rotation, extension, and external rotation occur as normally.

The labor may be much prolonged. Sometimes the pains may cease for a time, owing to the great resistance, or to the paralyzing effects due to the pressure on the soft parts between the fœtal head and the bony pelvis.

HEAD MOULDING. The head is markedly compressed in the suboccipito-bregmatic diameter and elongated in the occipito-mental. In profile it has the shape of a sugar-loaf. This is all the more marked if a large caput succedaneum has formed over the tip of the occiput.

FIG. 259.

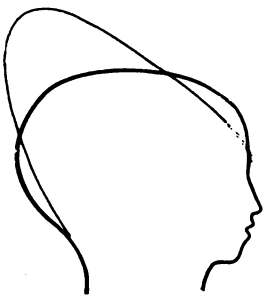


Diagram showing head unmoulded and moulded by labor in a justo-minor case.
Black, unmoulded.
Red, moulded.

TREATMENT. When the labor is delayed in a justo-minor pelvis forceps should be tried, provided the canal is large enough. This method may be employed when the brim conjugate is as low as 9.5 cm. (3¾ in.).

The forceps is used because it assists the natural mechanism—*i. e.*, it allows the head to be well fixed. Walcher's position and the employment of *axis-traction forceps* make it possible to deliver a normal head through a brim whose conjugata vera measures 8.4 cm. (3¼ in.).

Symphyseotomy may be recommended as an adjuvant to the above-mentioned method when the conjugata vera measures 7.6 to 8.4 cm. (3 to 3¼ in.).

Turning must not be employed, because the head becomes extended thereby, and the arms are apt to be displaced upward, greatly increasing the difficulty of a safe delivery of the head through the brim.

II. PELVES WITH ANOMALIES OF SIZE, SHAPE, INCLINATION, OR COMBINATIONS OF THESE.

1. *Those with Minor Developmental Peculiarities.*

(*a*) **Masculine.** Sometimes a woman's pelvis may present all the characteristics of a male pelvis.

Delay may be caused in labor either at the brim or outlet. Forceps may be required.

(*b*) **Shallow.** This term is applied to a pelvis in which the distance from the brim to the outlet is relatively less than in the normal pelvis.

Labor is not necessarily always easy in this form of pelvis. In the high forceps operation, however, there is less difficulty than in the case of a deep pelvis.

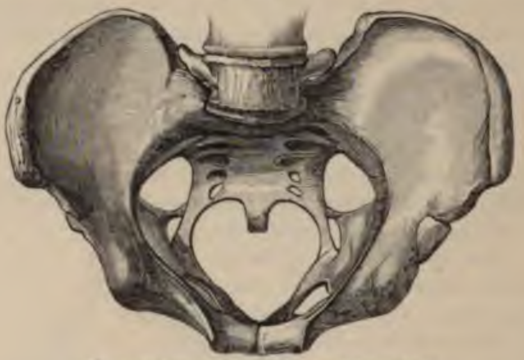
(*c*) **Deep.** In this pelvis there is an abnormal increase in the distance from the inlet to the outlet.

(*d*) **Funnel-shaped.** This term is applied to a pelvis in which there is a contraction of the pelvis at the outlet antero-posteriorly, transversely, or in both these directions. The canal, in fact, resembles that in the male pelvis, and by some authors "male" and "funnel-shaped" are used synonymously.

It must be remembered, however, that a pelvis may be funnel-shaped without possessing any other male characteristics.

DIAGNOSIS. The nature of the pelvis is made out by a careful comparison of the outlet and inlet measurements and by a careful examination of the pelvic canal.

FIG. 260.



Funnel-shaped pelvis. (After WINCKEL.)

INFLUENCE ON LABOR. The mechanism of labor may be interfered with—*i. e.*, flexion may be interrupted, or backward rotation of the occiput may occur. The labor is prolonged. The soft parts are unduly pressed against the bony wall—*e. g.*, the cervix against the promontory, or the bladder against the pubes, and laceration or necrosis may result. There is greater risk of rupture of the perineum.

TREATMENT. In the lesser degrees of contraction forceps should be used when there is delay. In more marked contractions, embryulcia, symphyseotomy, or Cæsarean section may be required. .

2. *Antero-posteriorly Contracted, or Flat Pelves.*

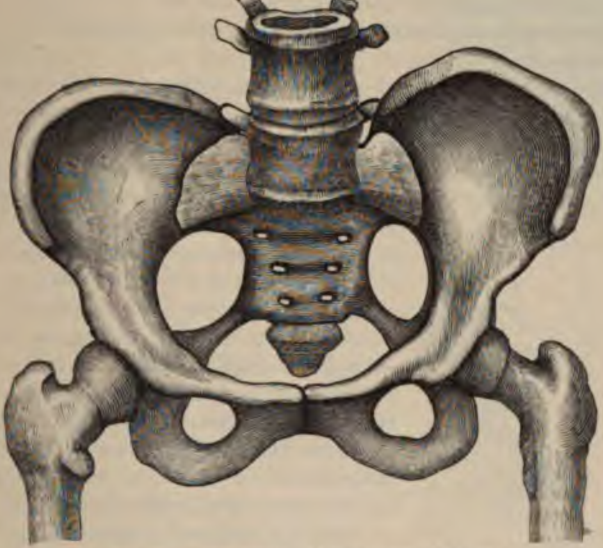
In these the characteristic feature is shortening of the conjugate of the brim.

(*a*) **Flat Non-rachitic, or Simple Flat.** This is a common variety in Europe, but rare in America. There is an approach of the whole sacrum to the pubes, the transverse diameter of the pelvis being, consequently, relatively increased. The conjugate in this form is rarely below three inches.

ETIOLOGY. The causes are not clearly known. Hard work in youth, a weakly condition of body, too early walking, lifting heavy weights, and excessive standing on the feet are believed to be important factors in causing the deformity. Sometimes the condition is congenital.

DIAGNOSIS. There may be nothing diagnostic in the build of the individual. It may be found in large and small women. The relationship between the intercristal and interspinous diameters may be scarcely altered from the normal, or not at all. There are no signs of rickets. The diagnosis is based upon the shortening of the external and diagonal conjugates.

FIG. 261.



Flat non-rachitic pelvis. (After KLEINWÄCHTER.)

(*b*) **Flat rachitic.** This is the most important form of flat pelvis. The following description may be regarded as that of a typical specimen.

FIG. 262.

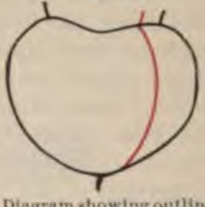


Diagram showing outline of brim of normal and Naegele pelvis.
Black, normal.
Red, Naegele.

In general, the pelvis is heavier than a normal one of corresponding size, owing to the increased condensation in the bones as a result of the disease. The bones are thicker, firmer, and somewhat smaller. The sacrum, however, is wider than normal.

The iliac crests do not possess the normal curve. They tend to become more or less everted at their anterior ends, so that the interspinous diameter approaches, equals, or is greater than the intercristal. The direction of the crests is partly due to the arrest of development, as the normal curve of the crests only appears after the age at which rickets occurs. The ilia are partly flattened also by the dragging of the sacro-iliac ligaments and the sartorii and glutei muscles. The iliac fossæ are not as distinctly hollowed, nor the iliac wings as expanded as in the normal pelvis; the fossæ look more directly forward. The wings are more stumpy than normal.

The brim is kidney-shaped, not heart-shaped, as in the normal pelvis.

The conjugata vera is less than the normal four inches, and the transverse is both relatively and absolutely increased.

The cavity of the pelvis is roomy and wider than in the normal state. The anterior surface of the sacrum is not concave from side to side, as in the normal condition, but, owing to the bulging forward of the bodies, it is either flat or convex.

The outlet has a widened transverse; the conjugate is normal or slightly increased.

The pubic arch is wide and the acetabula are directed more forward than in the normal state.

On vertical mesial section the symphysis is seen to be deeper than normal, its long axis not being parallel with that of the upper part of the sacrum, as in the normal condition, but tending to converge toward it above the brim. The main extent of the sacrum is straight from above downward. Usually a sharp bend occurs about the fourth vertebra. The relation of the conjugata vera to the conjugata diagonalis is not the same as in the normal pelvis. In the latter the difference between them is about half an inch. In the rickety the difference is greater, three-quarters of an inch or more, owing to two factors, viz., the increased depth of the symphysis and the divergence of the lower margin of the symphysis from the normal position.

FIG. 263.

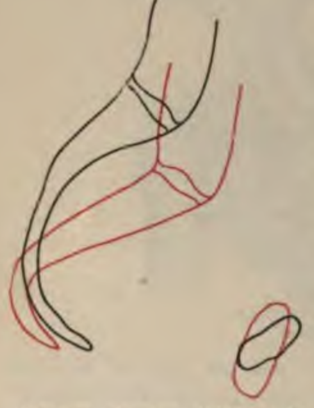


Diagram showing difference between normal and rachitic pelvis on vertical mesial section.

Black, normal. Red, rachitic.

ETIOLOGY. It is evident that these changes may be grouped around one main feature — the sinking of the promontory. Rickets causes in the early stages a softening of the bones, and if, in this condition, the body be kept to a considerable extent in the erect or sitting posture, its weight will tend to push the promontory downward and forward. The lower part of the sacrum, with the coccyx, tends to move upward and backward, but it cannot do so to any appreciable extent, on account of being held by the strong ligaments attached to it. Consequently, a sharp bend is produced about the fourth sacral vertebra. In addition to the weight of the body, the action of the muscles attached to the pelvis may help to bring about the deformity. The separation of the ischial tuberosities is due to the widening of the pelvis and to the action of the adductor and rotator muscles of the thigh. This will be increased by the weight of the body acting in the sitting posture.

Rickets usually develops in the early years of life. It may occur in utero, and the fœtus may be born with the pelvis somewhat altered; in the latter case probably the alterations are brought about by muscular action mainly. Great variations are produced by rickets, depending upon the date of its appearance, its severity, the habits of the child, etc. We have described the typical flat rickety pelvis. In some cases, where there is such a degree of disease as to permanently interfere with bone development, a condition of pelvis known as the *rachitic generally contracted pelvis* may be induced; or a *rachitic infantile* pelvis may result, in which there is a narrow transverse diameter, relatively to the conjugate. Sometimes the pubes may be bent inward toward the promontory by muscular action, causing the brim to have a *figure-of-eight* shape. When the disease begins after the child has learned to walk and run, the weight of the body is transmitted to the legs, and, owing to counter-pressure at the acetabula, they may be forced inward, thus giving rise to the *rachitic rostrate*, or *pseudo-malacosteon* pelvis.

When lateral curvature of the spine is present as a result of the rickets, the *scolio-rachitic* obliquely contracted pelvis is the result.

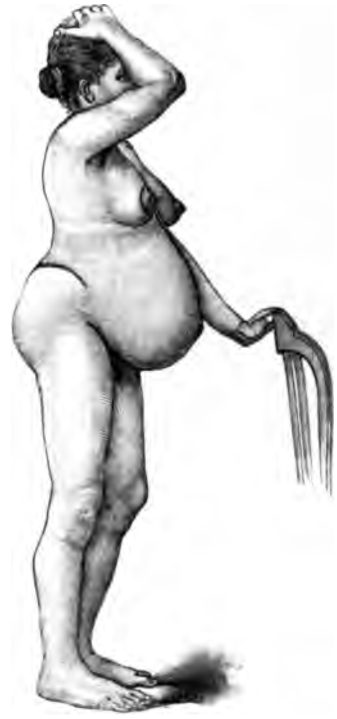
DIAGNOSIS. The diagnosis of a rachitic pelvis is formed from studying the woman's history, by her appearance, by examination and measurement of her pelvis. A woman who has suffered from the disease in childhood is usually undersized, with square head, flat nose, pigeon-breast, and with curved long bones whose ends are enlarged. When she lies on a flat surface, lumbar lordosis may be well marked.

By the pelvimeter the normal relationship between the interspinous and intercristal diameters is found to be altered, as already indicated. The external conjugate of Baudelocque is less than normal. The diagonal conjugate is less. The difference between the diagonal and true conjugates is greater than in the normal pelvis.

Sometimes a condition of double promontory exists, owing to the prominence of the junction of the first and second sacral vertebræ. In such a case the conjugates should be measured from the projection nearest the symphysis. Sometimes, on account of marked lordosis, the lumbar vertebræ may be nearer the symphysis than the real promontory; in this case the conjugates should be measured from the bony point nearest the symphysis.

INFLUENCE ON PREGNANCY AND LABOR. This has already been described (*vide* p. 413).

FIG. 264.



Pregnancy in a woman with a flat rachitic pelvis. The condition of pendulous belly is shown.

MECHANISM OF LABOR IN A FLAT RACHITIC PELVIS. Where the fœtus can be born, the passage of the head through the contracted brim takes place by a distinct and special mechanism.

In the normal pelvis the long diameter of the head lies at the beginning of labor, as Solayres first showed, in an oblique diameter of the brim. In the rachitic pelvis it lies in the transverse. In the normal pelvis the head is flexed; in the rachitic it becomes extended—*i. e.*, the sincipital end is lowered. In the normal pelvis the sagittal suture passes through the central point of the inlet; in the rickety pelvis, as Naegele first showed, the suture is nearer the posterior wall, or, in other words, the occipito-frontal plane of the head is oblique to the plane of the brim.

As the second stage of labor proceeds extension of the head increases, the sinciput dipping, the occipital end of the head being well against the side of the brim, the short, bitemporal diameter being in relation to the conjugata vera.

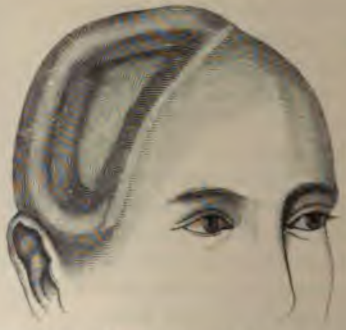
At the same time a movement takes place, known as the "rounding of the promontory." The head turns on its antero-posterior axis, so that the sagittal suture, instead of being near the promontory, approaches the symphysis; it then turns back again, so that the suture is nearer the back wall, now, however, being below the promontory. The head has, as it were, dodged round the promontory.

After the passage of the brim there is no obstruction in the true pelvis, and the rest of the mechanism may go on normally. Or, owing to the width of the transverse diameter of the outlet, the head may be forced onward without any special mechanism.

It is evident that should the head stick before it has passed the brim, different presentations may be made out clinically. Thus, a brow or face presentation may be found. One parietal bone may present, the sagittal suture being near the promontory, or the other parietal bone may present, the sagittal suture being near the symphysis.

Sometimes an altogether different mechanism may be attempted—*i. e.*, the head may attempt to get through one-half of the brim by a mechanism of extreme flexion. This mechanism may also be found in some cases of the *generally contracted rachitic* pelvis.

FIG. 265.



Depression of temporal region of skull as a result of delivery through a flat pelvis. (After E. MARTIN.)

Head Moulding. The characteristic feature is the presence of t "promontory mark"—*i. e.*, a depression in the parietal region whi is in contact with the promontory during the passage of the bri There is also generally a red mark on the skin, running from this depr sion toward the temple parallel with the coronal suture. Usually t parietal bone which was anterior in the pelvis overlaps the other.

BREECH DELIVERY IN A FLAT PELVIS. The delivery of the tru usually proceeds normally. The arms are more apt to be extended upward than in a normal pelvis. The after-coming head enters the brim in the transverse diameter. If the brim contraction is slight the head may pass through flexed; if great it becomes extended. Often it tends to stick above the brim.

Treatment. For a long period the classical method of treating a case in which the head presents has been that of version, providing the conditions are favorable. Recently, however, the use of the axis-traction forceps has been strongly advocated, mainly by Milne Murray, who claims that this method is as favorable to the child as version, and no more dangerous to the mother.

In a series of experiments Murray has shown that the diminution of the head in the occipito-frontal diameter is accompanied by a compensatory bulging, *not in the transverse*, but in the vertical diameter, and that, therefore, a serious objection to the use of the forceps is removed. By a simple and ingenious modification of the axis-traction forceps he has made it possible in these cases to make the line of traction coincide more accurately with the altered axis of the inlet than is possible with the ordinary axis-traction forceps. He and others have reported a number of cases in which his method has been successful in delivering a living child where marked contraction of the inlet existed. At the meeting of the British Medical Association in 1896 he mentioned one instance in which he had been successful where the brim conjugate measured 2.75 inches.

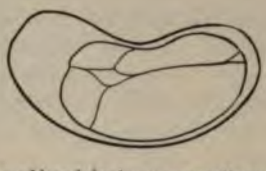
Comparing the relative merits of both methods in flat pelves, it may be stated against version (1) that it introduces the risks connected with breech deliveries, *e. g.*, asphyxiation of the fœtus from pressure on the cord, extension upward of head or upper extremities, injury to neck, etc.; (2) that it is impossible to bring down the child in the proper axis of the pelvis after version; (3) that turning becomes impossible or dangerous after the membranes have been for some time ruptured.

In favor of the forceps it may be said (1) that the fœtus is not exposed to the risks connected with head-last delivery; (2) that the manipulative risks are not so great as in version; (3) *that forceps can be applied long after dilatation of the cervix and rupture of the bag of membranes;* (4) that the fœtus may be withdrawn more nearly in the pelvic axis; (5) that in the widened transverse diameter of the brim the blades of the forceps may usually be applied to the head without great difficulty; (6) that the grip of the head, just sufficient to prevent slipping, does not dangerously compress the head; (7) that the compression produced causes a compensatory vertical, and not an antero-posterior bulging.

Of great assistance in these cases is the employment of Walcher's position. (See Plate XVIII.) The patient lies across the bed so that her lower limbs hang over the edge, the feet not touching the floor. The weight of the legs draws the symphysis downward, thus increasing the conjugate of the inlet and correspondingly diminishing that of the outlet. As much as one-third of an inch increase in the brim conjugate may be gained.

A head may be drawn through the brim in this position when it is impossible to do so in the left lateral or lithotomy position. It is recommended that when the head reaches the outlet the legs should be raised to make the conjugate of the outlet as long as possible; but as soon as the head has mainly passed the sacrum the limbs should be again placed in the Walcher position in order to relax the perineum. The raising of the legs is, however, unnecessary; the transverse is usually very wide in these cases, and the conjugate not diminished. There will, therefore, be little gain, even if the conjugate of the outlet be slightly increased.

FIG. 266.



Moulding of head during passage through flat rachitic pelvis.

FIG. 267.

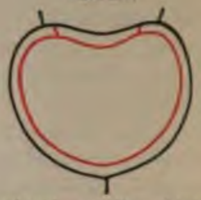
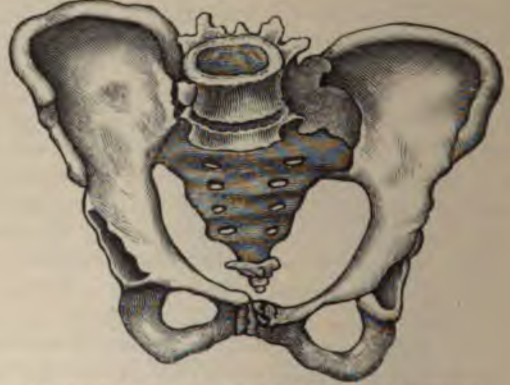


Diagram showing outline of brim of normal and of flat rachitic pelvis. Black, normal. Red, flat.

Where delivery is impossible by these methods, embryulcia or Cæsarean section have been employed, depending upon the degree of contraction. By many, premature labor has been induced in these cases in th hope of getting a living child with safety to the mother.

FIG. 268.



Singly obliquely contracted pelvis. (After HECKER.)

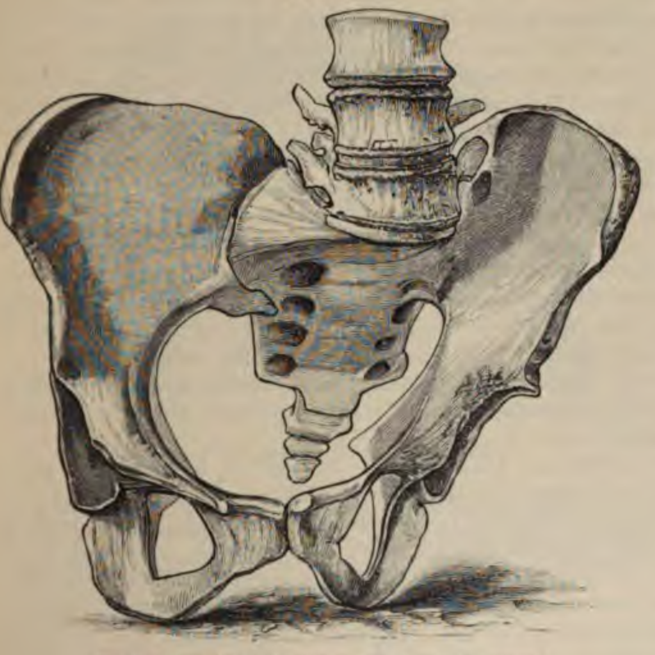
Recently the success of symphyseotomy has led to a very extensi abandonment of these latter methods, and there is no doubt that th operation will occupy a prominent place in the future. It should employed when the child is alive, when axis-traction forceps delivery the Walcher position is impossible, and when there is no doubt that th increased pelvic measurements resulting from the operation will allo the head to be extracted. Most authorities limit symphyseotomy in fl pelves to those cases in which the conjugata vera measures from 2.6 3.2 inches. It is evident, however, that the employment of the axi traction forceps in the Walcher position must make unnecessary, in nsiderable proportion of cases, the cutting operation. It is also ear that symphyseotomy at full time must greatly diminish the neces-ty for inducing premature labor in cases of pelvic deformity. For living child delivery at term by the axis-traction forceps with the id of a symphyseotomy is preferable to a premature delivery with ts risks and the uncertainty with regard to the rearing of a weakly hild.

The delivery of the after-coming head in breech cases is best effected with axis-traction forceps.

3. *Obliquely Contracted Pelves.*

(*a*) **Resulting from Imperfect Development of One Sacral Ala** (*Naegele Pelvis*). This pelvis varies somewhat in appearance, according to whether part or whole of the sacral ala is wanting. In a well-marked condition characteristic feature is the single oblique contraction of the brim. e latter is of somewhat ovoid shape, the small end of the ovoid ng at the sacro-iliac joint on the diseased side. The short oblique meter is that of the healthy side—*i. e.*, if the left sacral ala is want- the shortened oblique diameter of the brim is the right.

FIG. 269.



Singly obliquely contracted pelvis. (After WINCKEL.)

The sacrum is narrowed, the sacral wing on one side being partly or olly wanting. Often the sacro-iliac joint on that side is anchylosed. e front of the sacrum and the promontory are turned somewhat to the diseased side. The os innominatum on this side is pushed upward, inward, and backward as a whole. The ischial tuberosity on this side is higher than that on the other, the ischial spine being closer to the sacrum and projecting more prominently into the pelvic cavity. The ilio-pectineal line is often less curved than on the healthy side. The subpubic angle is asymmetrical and looks toward the diseased side. The acetabulum on the diseased side looks almost directly outward.

Etiology. The deficiency in the sacral ala is due either to non-development or to some diseased state—*e. g.*, inflammation in early life. It may, therefore, be a congenital condition.

The distortion is aggravated when the child begins to walk, and it is easy to understand how the displacement of the os innominatum on the diseased side may be brought about. It is important to note that anchylosis of the sacro-iliac joint is not primary in this deformity; it is secondary, and is not always present.

Diagnosis. The diagnosis of the Naegele pelvis, especially where only part of the sacral ala is wanting, may be a difficult matter. The following measurements should be made with the pelvimeter: (1) From the anterior superior spine of one side to the posterior superior of the opposite; (2) from the posterior superior spine of one side to the tuber ischii of the other; (3) from the spine of the last lumbar vertebra to the anterior superior iliac spines of both sides; (4) from the posterior superior spine to the great trochanter on the opposite side; (5) from the lower margin of the symphysis to the posterior superior iliac spines.

These right and left measurements must be compared. Normally they should be equal or nearly equal. In the marked Naegele pelvis there is a considerable difference. Two other measurements may also be made, viz., from the middle line of the back to the posterior superior iliac spines; from the lower edge of the symphysis to the ischial spines, and from these spines to the nearest point of the sacrum.

Internal examination of the pelvic cavity must be made in order to detect the displacement of the lower portion of the os innominatum on the diseased side.

Influence on Labor. If the pelvis is roomy or the deformity slight, there may be no delay in the labor. When the contraction affects the passage of the head the mechanism by which it attempts to pass the brim is the same as in the case of a justo-minor pelvis—*i. e.*, by extreme flexion, the antero-posterior diameter of the head being in relation to the long oblique diameter of the pelvis. As the head descends it may fail to rotate to the front, and may turn to the back.

In a small pelvis with much contraction delivery is impossible.

Treatment. The axis-traction forceps should be tried where ther is delay. Version is recommended by some, but owing to the nature the contraction the former method is most indicated. Embryulcia ha been used.

Premature labor may be induced as an alternative method. In extrem degrees of contraction Cæsarean section should be tried.

Symphyseotomy should not be employed, owing to the anchylosis the sacro-iliac joint.

(*b*) **By Imperfect or Abolished Use of One Limb.** This may follo

straight in its vertical direction. The ilia extend somewhat behind the sacrum, and there is a tendency to shortening of the conjugate of the brim.

In some cases both sides of the sacrum may not be equally maldeveloped. More than the sacral wings may be affected. There is usually secondary anchylosis of the sacro-iliac joints.

TREATMENT. Cæsarean section must be employed.

(*b*) **By Kyphosis of the Spine** (see page 449).

5. *Compressed Pelves.*

(*a*) **Malacosteon.** Various degrees of this condition are met with. In a typical well-marked specimen the following points are noticeable. The false pelvis is greatly altered in shape. The iliac fossæ, instead of having the normal saucer-like hollowing, are scoop-shaped, owing to the marked bending of the iliac wings, the anterior superior iliac spines turning inward.

The brim has a characteristic triradiate or stellate shape, owing to the approximation of the promontory and the acetabula. The pubic bones are close together, forming a kind of projection or beak. Hence this pelvis is often known as the rostrate or beak-shaped pelvis. The pubic arch is very narrow. The descending rami may be somewhat twisted. The ischial tuberosities are approximated and may be somewhat bent. The lower end of the sacrum with the coccyx is curved upward into the pelvic canal.

FIG. 272.

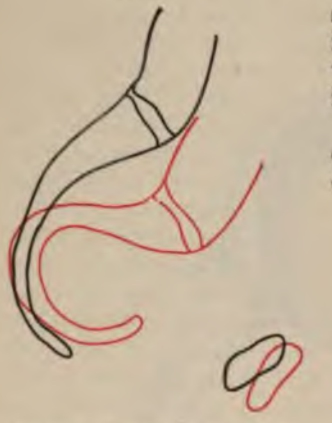


Diagram showing difference between normal and malacosteon pelvis on vertical mesial section.
Black, normal.
Red, malacosteon.

FIG. 273.

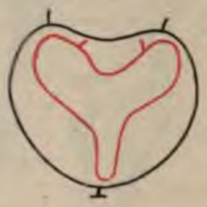


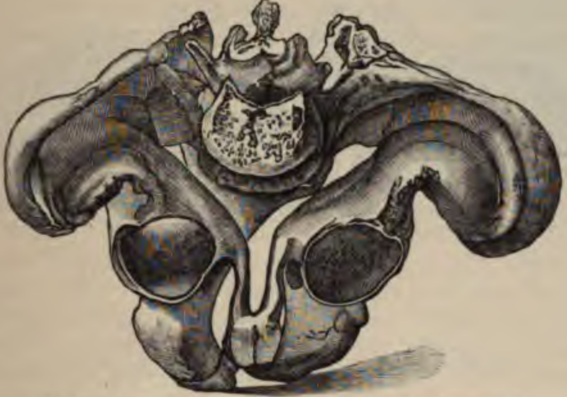
Diagram showing outline of brim of normal and of malacosteon pelvis.
Black, normal. Red, malacosteon.

ETIOLOGY. The deformity is brought about when the pelvis is softened by the disease, osteomalacia (mollities ossium). This condition usually develops in the puerperium, but may occur in pregnancy. There is a removal of the lime salts from the bones. In the softened condition of the pelvis it is easy to understand how the weight of the body, the resistance of the lower limbs at the acetabulum, and the sitting posture may result in a crushing in of the pelvis, as has just been described.

DIAGNOSIS. The diagnosis is based on the history of the case and on external and internal examination of the pelvis. The gait is generally peculiar: the body rotates greatly as one foot is advanced in front of the other.

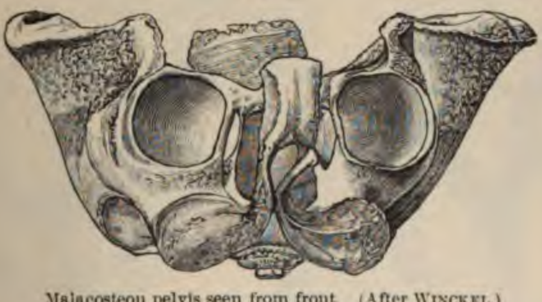
INFLUENCE ON LABOR. In the softened condition of the bones labor may proceed naturally, though there are great dangers to the mother. In eighty-five cases collected by Litzmann there was a mortality of forty-seven. In the hardened condition, natural delivery is, in the great majority of cases, impossible

FIG. 274.



Malacosteon pelvis, seen from above. (After WINCKEL.)

FIG. 275.



Malacosteon pelvis seen from front. (After WINCKEL.)

TREATMENT. In the softened condition of the bones forceps and version have been employed to aid delivery. Now, however, in these cases it is extremely likely that Cæsarean section with removal of the ovaries, or Porro's operation, will be employed, because of the curative influence which extirpation of the ovaries exerts on the disease.

When the bones are hard and the deformity fixed, the procedure depends upon the degree of contraction.

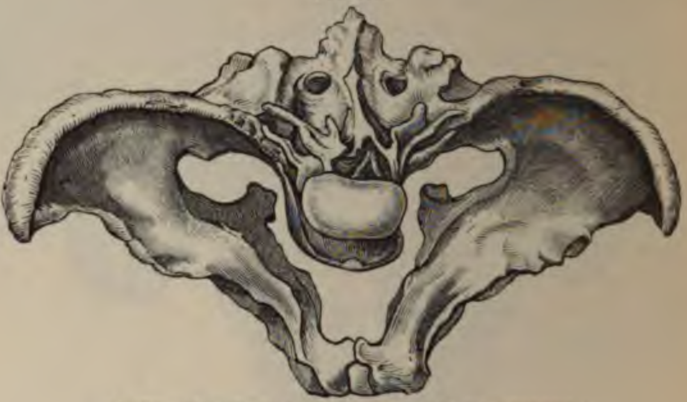
Embryulcia may sometimes be employed, but in the great majority of cases Cæsarean section must be carried out.

(*b*) **Pseudo-malacosteon Rachitic.** This form has already been alluded to in connection with rickets.

The pubis projects as a beak, the acetabula being somewhat pressed inward. The iliac wings are not scoop-shaped, as in the true malacosteon, but are widely separated anteriorly, as in the typical rachitic condition.

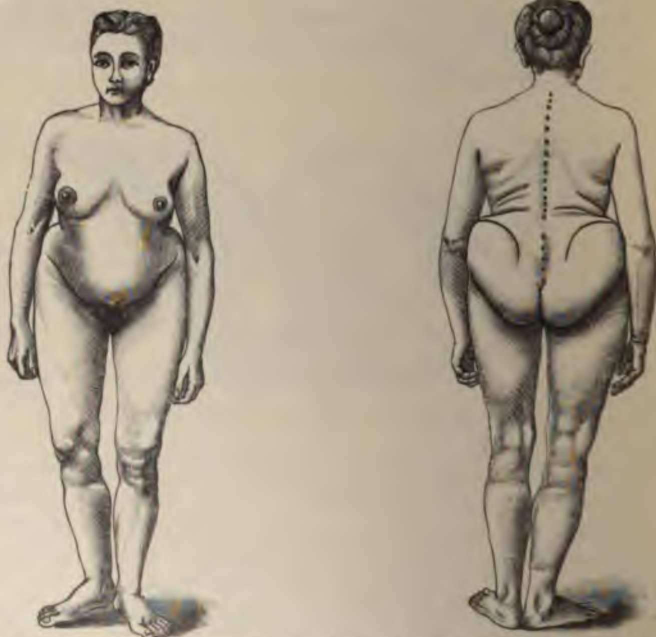
ETIOLOGY. This condition is due to rickets (see page 433).

FIG. 276.



Pseduo-malacosteon rachitic pelvis. (After SCHROEDER.)

FIG. 277.



Front and back view of woman with moderate degree of spondylolisthesis. (After WINCK

6. *Spondylolisthetic Pelvis.*

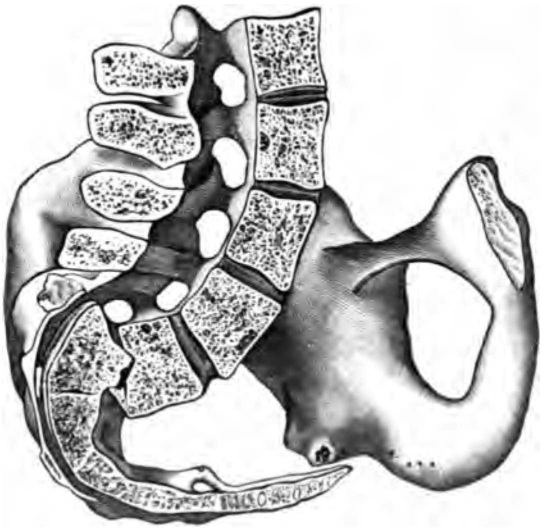
The characteristic feature in this deformity is the projection of lower lumbar vertebræ into the true pelvis, owing to their down displacement. The sacrum is pushed somewhat backward and downward, and the symphysis rises. The inclination of the brim is thereby greatly lessened. The conjugate of the pelvis is diminished, varying according to the amount of descent of the vertebræ. The iliac crests are separated somewhat posteriorly.

The pelvic outlet is narrowed both transversely and antero-posteriorly.

ETIOLOGY. The causation of this condition is not very clear. Injury, disease, and developmental errors are believed to be predisposing causes. Lane believes that extra pressure from above may bring about the condition, even when the bone is healthy.

DIAGNOSIS. The history must be carefully studied. There may have been an accident—*e. g.*, a fall, or the woman may have been accustomed to carry heavy weights. The height is diminished and the abdomen shortened vertically, and it is somewhat pendulous. Seen from behind the posterior parts of the iliac crests are very prominent. The articular processes of the first sacral and last lumbar vertebræ are very distinct below the skin. The ribs are close to the ilia and the flanks are well marked. The shoulders are carried well back. When the woman walks the footsteps fall in a straight line, the toes not turning outward. Sometimes she complains of a grating sensation (crepitus) in the lumbar region.

FIG. 278.



Spondylolisthetic pelvis. (After E. MARTIN.)

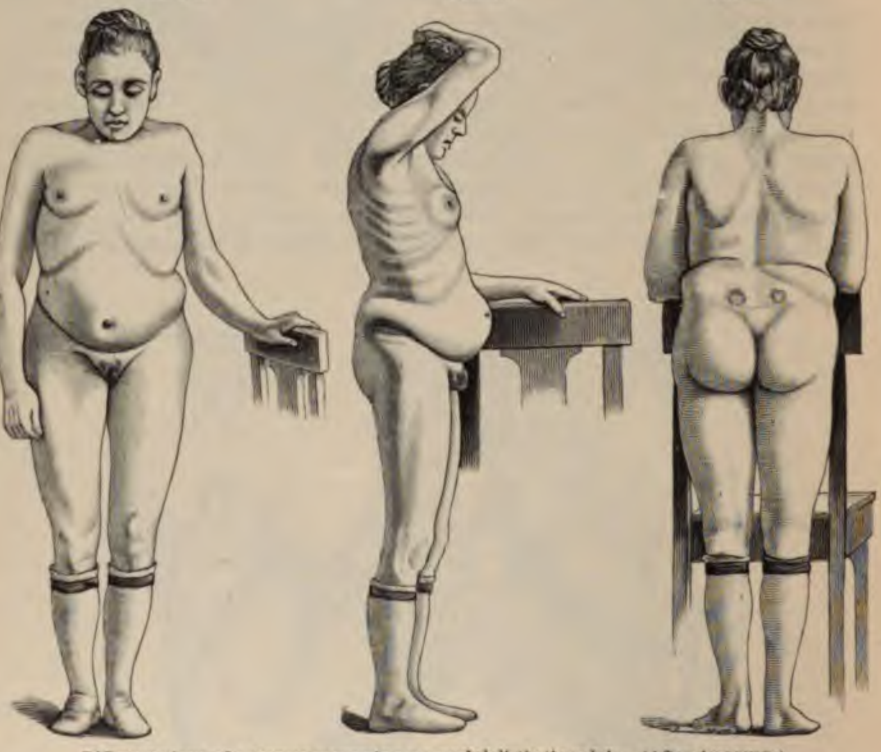
Owing to the rotation on the pelvis, the vulvar region is carried forward. On external examination the symphysis is found to be higher than normal, the brim with a lessened inclination, the distance between the posterior superior iliac spines increased, and the external conjugate of Baudelocque diminished.

On internal examination the projection of the lumbar vertebræ is distinguished, as well as the contracted outlet. The iliac vessels are lower than normal, and it may be possible to feel the lower end of the aorta.

The diagonal conjugate must be measured from that point on the lumbar projection nearest the symphysis. Owing to the variations in the inclination of the pelvis and in the degree of deformity, there is no constant relationship between the diagonal and true conjugates. The former is generally a little greater, but it may be equal to or less than the latter in a few cases.

INFLUENCE ON LABOR. The deformity being of the nature of a flattening of the pelvis, the mechanism of labor, providing the head can be born, resembles that found in a flat rachitic pelvis. In some cases natural delivery is impossible. Bad ruptures of the pelvic floor are common.

FIG. 279. FIG. 280. FIG. 281.



Different views of a woman possessing a spondylolisthetic pelvis. (After AHLFELD.)

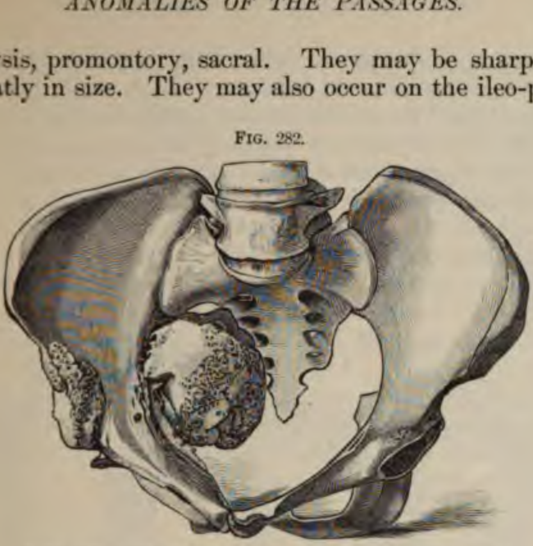
TREATMENT. Labor is conducted on practically the same lines as laid down in connection with rachitic pelves.

7. *Pelves Distorted by Injuries, Disease, Tumors, etc.*

(*a*) **Double Dislocation Backward of the Femora.** This rare condition is generally congenital. It results in marked rotation forward of the sacrum, increased width of the pelvic cavity and outlet, the tuberosities of the ischium being dragged outward, upward, and backward.

(*b*) **Tumors.** The commonest are exostoses at the joints—*e. g.*, sacrophysis, promontory, sacral. They may be sharp or rounded, greatly in size. They may also occur on the ileo-pectineal line.

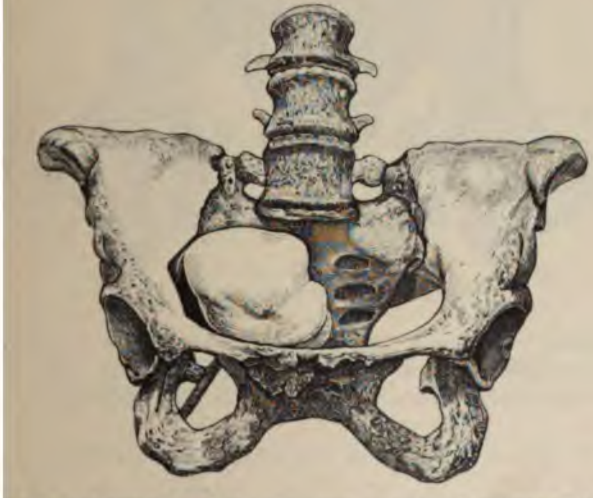
FIG. 282.



Bony outgrowth of right half of pelvis. (After WINCKEL.)

exostoses may interfere with normal labor, and they may injure ernal and fœtal parts.

FIG. 283.



t growth of posterior wall of pelvis which necessitated Cæsarean section in a case of Dr. Cameron.

tumors of the bone may distort the pelvis—*e. g.*, fibroma, sar- cinoma, enchondroma, cysts. Cystic conditions occur in sar- chondroma, and hydatids. Carcinoma is always a secondary it may lead to great softening of the bone.

MENT. Where the growth is too large to admit of delivery by al passages, Cæsarean section or embryulcia must be performed. otomy is sometimes performed in these cases, but not where the sacro-iliac joints are involved in the tumor. Embryulcia is to be especially considered if the child be dead.

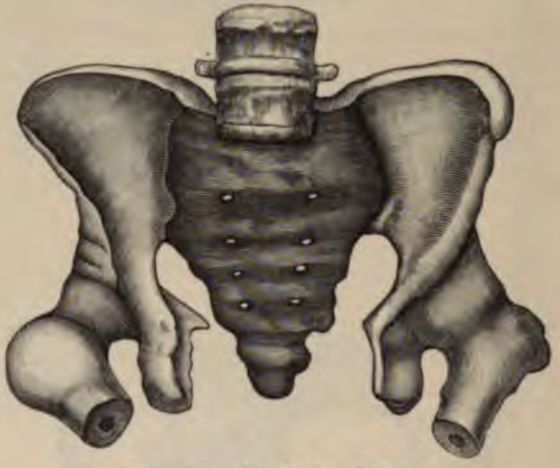
(c) **Fractures of the Pelvis.** Deformity due to this injury is very rare. It may result from bad union of the broken bone, from marked callus-formation, or from ossification of the joints near the fracture.

(d) **Anchylosis of Joints.** This condition may occur in any pelvic joint. When at the symphysis, it is not a serious matter as regards labor; but it makes symphyseotomy a more difficult operation.

In the sacro-iliac joints it is a more serious matter. When it occurs in early life it may interfere somewhat with the development of the adjacent parts of the sacrum and ilium, and so the pelvis may be somewhat obliquely contracted. This is a rare condition, however.

The sacro-coccygeal and coccygeal joints may sometimes become anchylosed. More commonly the sacro-coccygeal alone is affected. In the former case there may be marked obstruction to labor, and fracture of the coccyx may result.

FIG. 284.



Split pelvis. (After KLEINWÄCHTER.)

(e) **Split Pelvis.** This is a rare condition, being due to a maldevelopment in the anterior wall of the pelvis. It is not a cause of delay in labor, but is rather apt to be associated with rapid delivery.

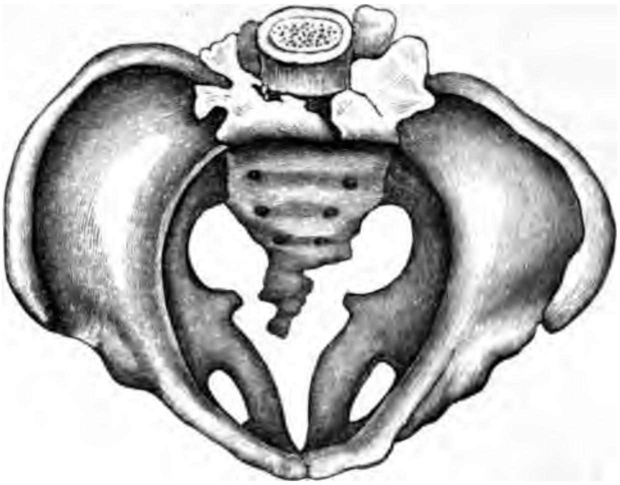
8. *Pelvic Deformities Due to Spinal Curvature.*

(a) **Kyphotic.** This deformity varies greatly, according to the extent of the kyphosis. The nearer the sacrum the spinal hump, and the more prominent it is, the more marked the changes in the pelvis. Generally the kyphosis is in the region of the junction of the dorsal and lumbar vertebræ.

Owing to the spinal curvature the centre of gravity of the body above it is thrown forward. Some degree of lordosis is brought about by way of compensation, but this is not sufficient, and a rotation of the sacrum occurs, so that the upper end is thrown backward and downward. There is also a rotation of the ossa innominata upon their antero-posterior axes.

The characteristic alteration in the pelvis is the change in the brim, from the normal heart-shape to an oval, in which the long diameter is antero-posterior. This results from the backward movement of the promontory, whose prominence may entirely disappear. The sacrum becomes longer, narrower, and straighter. The posterior superior iliac spines are drawn nearer to each other and the anterior are separated.

FIG. 285.



Kyphotic pelvis. (After KLEINWÄCHTER.)

The pelvic canal may become markedly funnel-shaped, owing to the movement forward of the lower part of the sacrum, and to the approximation of the ischial tuberosities; but many variations are found in the degree of contraction. The lower the kyphosis the more will the portion of the spine which projects forward tend to interfere with the brim.

FIG. 286.

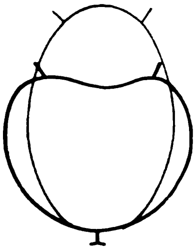


Diagram showing outline of brim of normal and of kyphotic pelvis. Black, normal. Red, kyphotic.

FIG. 287.

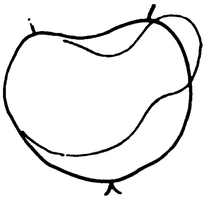


Diagram showing outline of brim of normal and of scoliotic pelvis. Black, normal. Red, scoliotic.

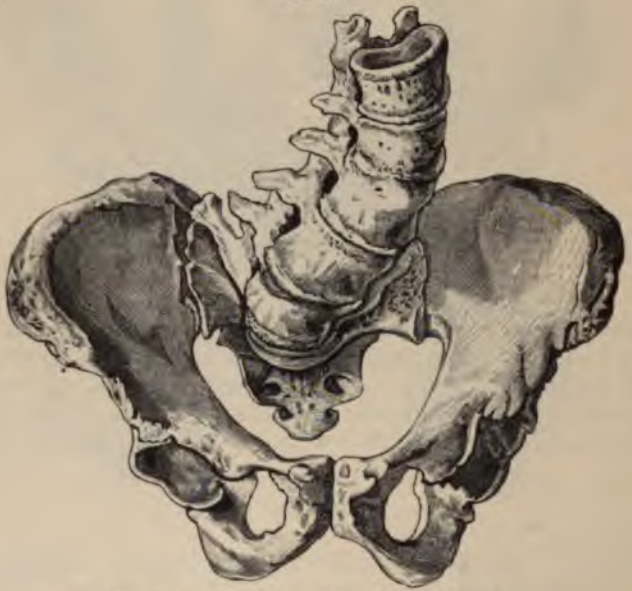
Sometimes the upper part of the sacrum may be affected by the necrosis which has caused the kyphosis, and some extra deformity may thus be brought about in the sacrum.

DIAGNOSIS. The diagnosis is easy from examination and from the woman's history. The condition of the cavity and outlet especially must be noted with extreme care.

INFLUENCE ON LABOR. The obstruction to labor occurs in the lower part of the pelvic canal. If the degree of contraction is slight, labor may be easy and quick. So frequently may this be the case that a saying is common in some parts of Europe to the effect that "Hunchbacks have easy labors." In a marked degree there is delay, and abnormal rotation of the head is apt to occur. In a more marked degree of contraction birth is impossible. There is special danger of post-partum hemorrhage, owing to the imperfect filling of the upper part of the pelvis by the uterus.

TREATMENT. This varies according to the degree of contraction. In slight cases forceps may be used successfully. In worse cases embryulcia or premature labor may be necessary. In extreme contraction Cæsarean section is demanded.

FIG. 288.



Kyphoscoliotic-rachitic pelvis. (After AHLFELD.)

(*b*) **Scoliotic.** When lateral curvature affects the spine its effect on the pelvis depends on its situation and extent. The lower the bend in the spine and the earlier its occurrence, the more marked will be the pelvic deformity. As scoliosis is generally associated with rachitis, the scoliotic pelvis will show certain changes due to that disease. The special alterations induced by the spinal condition are as follows: That half of the pelvis toward which the convexity of the curvature is directed receives an extra amount of the weight of the body. The innominate bone, therefore, on that side tends to be pushed upward, backward, and inward by the resistance of the femur. The acetabulum is curved in somewhat toward the sacrum, so that the shortest diameter of the brim is that between the promontory and the ilio-pectineal eminence, the so-called cotyloid diameter. There is also some rotation of the lumbar ræ toward the side of the convexity. If there is much rachitis omontory may be well forward, the sacral wing on the side of the convexity being prominent. Thus the marked deformity is seen on the side of the convexity.

FLUENCE ON LABOR. When only slight degrees of deformity exist ild is born by the mechanism observed in the case of the rachitic s. If the deformity be more marked, one-half of the pelvis, viz., on the side of the convexity, is of no use, and the head may attempt ss the larger part of the brim by a mechanism like that seen in a ersally contracted pelvis. Embryulcia has been employed in some of cases. Symphyseotomy has also been tried. But, practically, in ses where deformity is at all marked, Cæsarean section is indicated.

Kyphoscoliotic. Rachitis may cause both kyphosis and scoliosis in me woman. If both are situated low in the spine the pelvis may certain characteristics due to both these conditions. Generally the osis is situated high in the dorsal region, and is compensated for by nbar lordosis, so that the pelvis is not affected by the kyphotic ture.

FIG. 289.

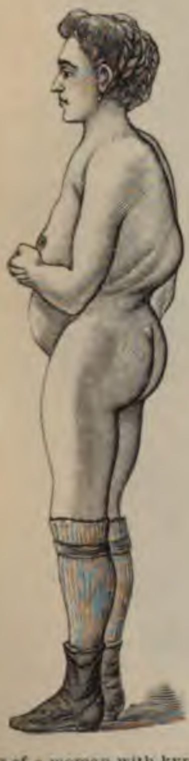
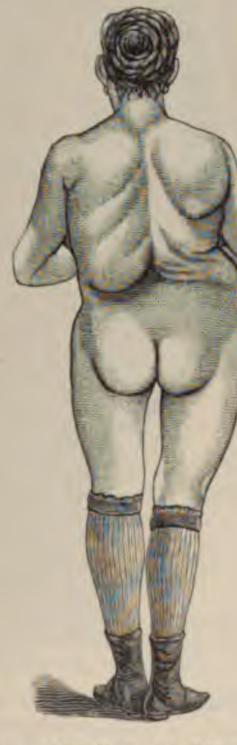


FIG. 290.



Views of a woman with kyphoscolio-rachitic pelvis. (After MARTIN and FASSBENDER.)

Lordosis. Primary lordosis is so rare a condition that no notice

need be taken of it in this connection. It is usually secondary to
disease or to pelvic deformity.

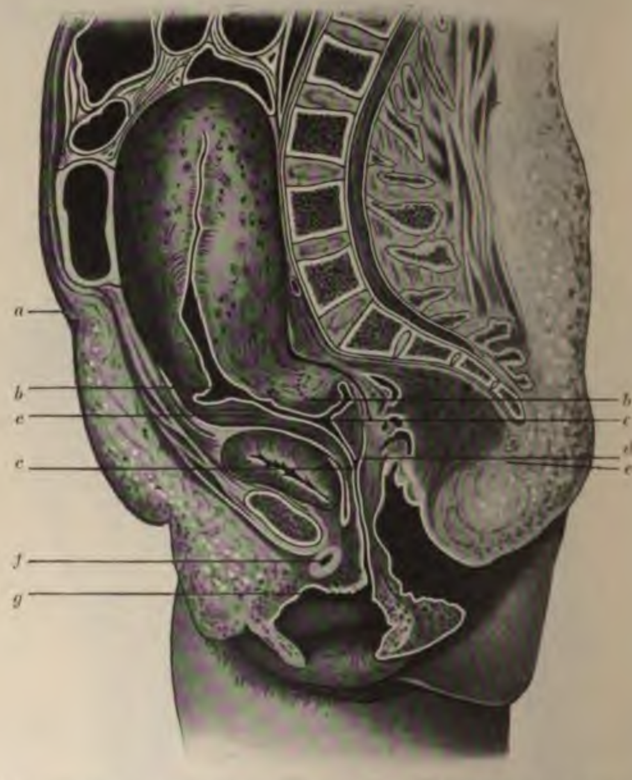
If low down in the spine, it may interfere with the uterus in p
and with the entrance of the child in the brim during labor.

Pelvic Deformity in Relation to the Post-partum State.

That a deformed pelvis may exert a marked influence on the c
of the post-partum state is not generally recognized; yet careful o
tions show that the relationship is one which cannot be ignored.

Some years ago it was the writer's good fortune to be able to i
gate the cadavera of a number of women who died at various per

FIG. 291.



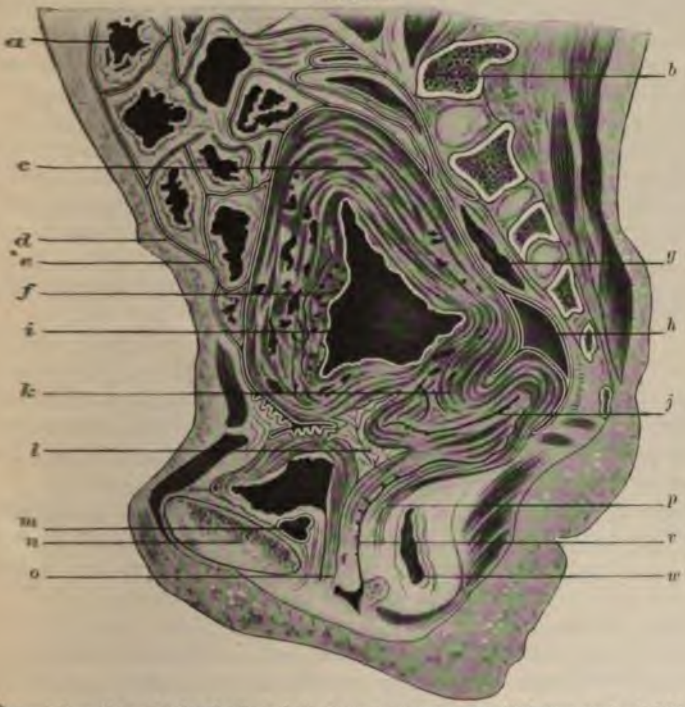
Vertical mesial section of a contracted pelvis, from a woman who died a half-hour after
of post-partum hemorrhage.

a. Umbilicus; *b*, retraction ring; *c*, cervix; *d*, posterior fornix; *e*, tip of coccyx; *f*,
g, urethral orifice. (STRATZ.)

the puerperium, of conditions not affecting the normal relationsh
the pelvic contents. By means of frozen sections it was possi
describe accurately, for the first time, the topography of the pu
pelvis. Sections showed that in the normal state, immediately af
third stage, the retracted and contracted uterine body fills the

part of the pelvic cavity and compresses the extra-uterine tissues, this compression being especially marked between the uterus and the bony wall, and to a much less extent inferiorly, owing to the softening and relaxation of the fascial and muscular tissues of the floor of the pelvis. In consequence of this arrangement the circulation of the blood in the extra-uterine pelvic structures is considerably interfered with, those parts inferior to the body of the uterus—viz., the cervix, vaginal walls, perineum, and subpubic tissues—being congested, while those tissues compressed between the pelvic wall and uterine body are anæmic, many of he vessels being closed or nearly closed. In the uterine body itself there is marked anæmia, owing to the compression of vessels by the retracted and contracted musculature. This condition of things lasts for the first four days of the puerperium. Both as a result of the state of the uterus and of the compression of extra-uterine tissues by the organ against the pelvic wall, bleeding from its inner surface is greatly interfered with, while a marked influence is exerted by the greatly altered circulation in the direction of initiating or assisting the retrogressive changes which cause uterine involution. Further, the condi-

FIG. 292.



Vertical mesial section of a kyphotic pelvis, from a woman who died one and a half hours after delivery, of post-partum hemorrhage.

a, intestines; *b*, last lumbar vertebra; *c*, uterus; *d*, peritoneum; *e*, placental site; *f*, uterine cavity; *g*, rectum; *h*, pouch of Douglas; *i*, cervix; *j*, cervical canal; *k*, cellular tissue; *l*, bladder; *m*, vein; *n*, symphysis pubis; *o*, urethra; *p*, cellular tissue; *v*, vagina; *w*, anus. (BARBOUR.)

tion of the cervix and vagina aids to an understanding why after labor there is so often bleeding as a result of tears; and why, if the laceration has extended into the paracervical and paravaginal tissues so rich in venous sinuses, there may be very severe hemorrhages.

During several years the writer has made careful observations regarding post-partum hemorrhage in cases of normal and abnormal pelves, and he has found it to be most profuse and most difficult to check in women with abnormally large pelves and in those with abnormally contracted pelves. Of the former, may be mentioned the justo-major or universally enlarged, and the kyphotic, in which the upper part of the pelvic cavity is much increased; of the latter I may mention the rickety pelvis. The explanation of these facts is very evident from the study of cadavera. Barbour, of Edinburgh, has published an interesting case of a kyphotic woman who died one and a half hours after delivery, of post-partum hemorrhage, and his sections of the frozen body show that the uterus in no way acts as a plug to the large size of the upper part of the pelvic cavity, the extra-uterine tissues being markedly congested, the large vessels dilated—conditions all favorable to excessive bleeding. On the other hand, in the case of a well-marked contracted brim, as is shown by Stratz's section of a rickety woman who died of post-partum hemorrhage one-half hour after delivery, the uterus cannot sink down into the pelvis, the cervix, vagina, and extra-uterine pelvic tissues being thereby allowed to become enormously congested.

The Prevention of Dystocia.

During the last century various attempts were made to influence the growth of the fœtus during its intra-uterine life, so that labor might be rendered less difficult in cases in which there had been dystocia. These consisted in purging, bleeding, or underfeeding the mother.

In 1841 Rowbotham, a London chemist, published a pamphlet describing the success which had followed the treatment of his wife by restriction of her diet. For many years his system was carried out among the laity, but was little noticed by the profession.

In 1889 Prochownick gave an account of some cases in which he claimed that pregnancy had been made to terminate in satisfactory full-time labors by dietetic restrictions to which the mothers were subjected during the last two months of pregnancy. He believed that this method of treatment would result in the development of a small fœtus, which might in a large percentage of women with contracted pelves be born at full time, thus rendering serious operations and induced premature labor less frequently necessary. He emphasizes the increased capacity of the skull for moulding.

His diet was as follows:

Morning: Small cup of coffee and 6 drachms of Zwieback.

Noon: Any kind of meat, eggs, or fish, with very little sauce. Some green vegetable, with fat added. Salad, cheese.

Evening: As above, with addition of 1½ ounces of bread. Butter as desired.

Fluids, per diem, limited to 12 or 15 ounces of red or Moselle wine.

To be entirely avoided: Water, soups, potatoes, cereals, sugar, beer.

Several workers have reported successful cases treated by Prochownick's method, but it has not been sufficiently tested to warrant its widespread adoption.

B. Soft Parts.

1. Uterus.

DEVELOPMENTAL ANOMALIES.

When labor takes place in the case of a unicornate uterus there are apt to be malpresentations and positions, mainly owing to the inclination of the long axis of the cornu to the pelvic canal.

In the case of pregnancy in one horn of a bicornate uterus the same tendency exists. Here also labor may be obstructed by the recto-vesical ligament which runs between the cornua. Where both horns are pregnant obstruction is likely to occur from jamming together of the twins.

In the case of a pregnancy in one half of a septate uterus, the unimpregnated half may act as a mechanical obstruction or the septum may do this.

In all these cases the labor pains may often be weak, short, and inefficient. Rupture of the uterus may occur. Severe post-partum hemorrhage may result.

TREATMENT. It may be necessary to assist delivery by version or forceps. In such cases the greatest care should be used in order that the uterine wall be not ruptured. Version should be employed as little as possible. Embryulcia or Cæsarean section may be necessary sometimes. When a septum is an obstruction it may be cut through.

When pregnancy occurs in the rudimentary horn of a bicornate uterus, the case is very grave and must be treated as one of tubal gestation.

ATRESIA OF THE CERVIX.

This is acquired after conception, usually from the use of escharotics, and is seldom complete. Generally a dimple exists at the site of the os externum. If the condition be not relieved rupture of the uterus will take place.

TREATMENT. With a sound a small opening may be made through the dimple. Sometimes it is necessary to make a crucial incision. Dilatation usually follows naturally. If there is sharp bleeding, ligatures may be necessary.

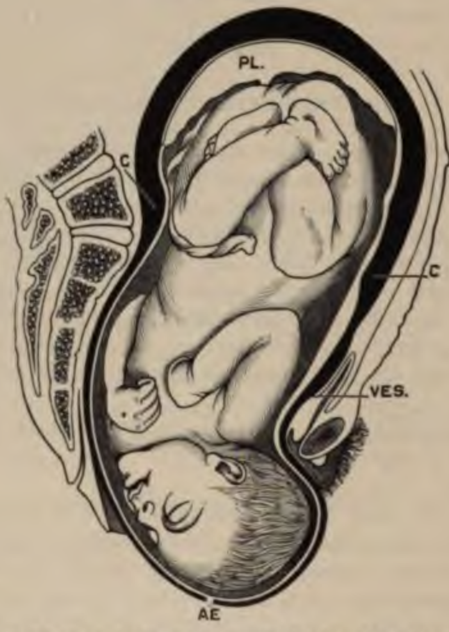
RIGIDITY OF THE CERVIX.

This condition causes delay in the first stage of labor. It may be functional or organic. Functional rigidity is either *constitutional*—*e. g.*, as met in elderly primiparæ, or *spasmodic*. In the latter condition, the cervical sphincters do not relax between the pains, and the *os externum* tends to become smaller during the pains. This condition is usually associated with inefficient contractions of the body of the uterus.

Organic rigidity is due to various causes. Former lacerations may have led to the formation of much cicatricial tissue in the cervix, or this condition may succeed operative procedures.

Syphilitic changes or new growths sometimes cause rigidity.

FIG. 293.



Stenosis of the cervix uteri obstructing labor. (After JENTZER.)

TREATMENT. In the constitutional, spasmodic, and inflammatory varieties, hot douches, frequently given, are serviceable. Chloral, morphia suppositories, or large doses of opium in pills may be administered. Large doses of chloral are to be preferred, because this drug causes dilatation painlessly without interfering with the pains; morphia tends to suspend the pains. If the patient be exhausted chloroform may be given, and a hypodermic of morphia to induce sleep for a few hours.

It may be necessary to assist dilatation by separating the membranes from the lower uterine segment as much as possible and by pressing the lips of the cervix apart with the fingers. Rubber dilators, *e. g.*, Barnes's or Champetier de Ribes's, are valuable when the other methods fail.

Sometimes several incisions, one-half inch deep, must be made in the cervix. These should immediately precede artificial delivery.

IMPACTION OF THE CERVIX.

In the case of rigid cervix, hypertrophy of the cervix, or in pendulous belly, where the os externum is directed to the back, the anterior lip may be caught between the head and the pubes, and, becoming swollen and œdematous, may impede labor, or, after labor, may slough. In these attempts should be made to push the cervix up between the pains. en this is impossible, it is best to draw the head through with forceps make incisions in the cervix.

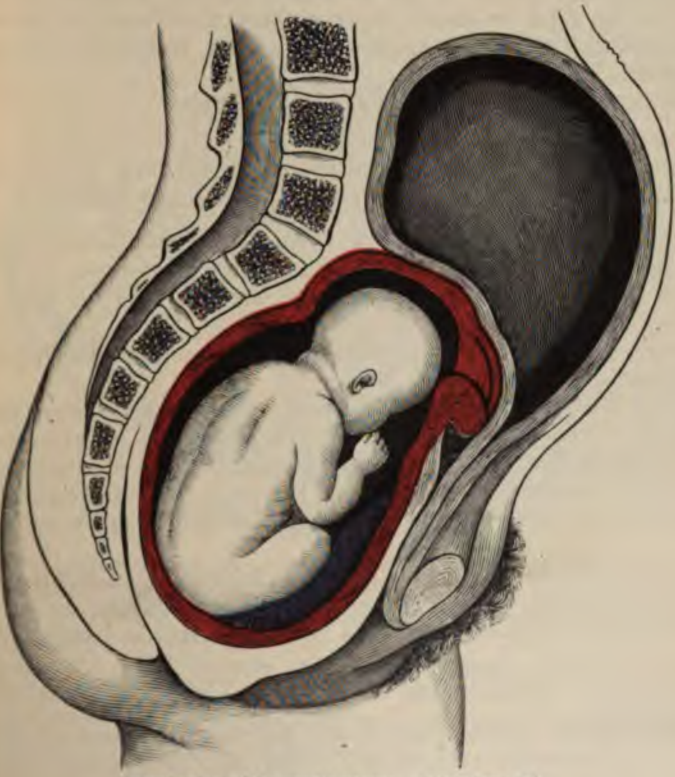
MALPOSITIONS OF THE UTERUS.

nteversion. When there is marked anteversion in pendulous belly, s a result of separated recti, the uterine force may be so badly directed dilatation takes place very slowly.

REATMENT. The patient is kept on her back, an abdominal binder g used to hold the uterus in position.

ernia. A pregnant uterus may fall into an umbilical hernia or into entral hernia following a laparotomy. Sometimes an inguinal hernia contain a pregnant uterus.

FIG. 294.



Retroflexion of the gravid uterus. (After SCHATZ.)

EATMENT. The dorsal position and the binder are employed to the uterine axis properly directed. In the case of an inguinal a the child may be delivered by version, and the uterus afterward drawn from the hernia. But it is probably best to open the hernial removing the fœtus from the womb and amputating the latter. This ition is usually found with a unicornate or bicornate uterus.

Latero-version. Marked tilting of the fundus to one or other side may sometimes occur. The patient should be placed on the side toward which the fundus is directed, and a pillow should be put under that side of the belly during labor.

Sacculation. Where a retroflexion of the gravid uterus has occurred in the early months, the pregnancy having advanced to term, there may be formed a kind of diverticulum behind the cervix, the latter being usually above the brim against the abdominal wall. The posterior vaginal wall is markedly bulged downward and forward, and the fœtal parts may be so easily felt as to suggest an ectopic gestation; or the projecting vagina may be mistaken for a bag of membranes.

Treatment. The cervix should be dilated artificially and version performed. It may be necessary sometimes to perform Cæsarean section.

Prolapsus Uteri. Complete prolapse of the pregnant uterus is unknown. Various degrees of partial prolapse have been met with.

Often when pains set in the prolapsed portion is drawn up. But if the cervix be rigid or much hypertrophied, this does not happen, and the prolapsed portion may become œdematous, and, consequently, more pronounced.

Treatment. See "Impaction of the Cervix."

Labor in Cases in which Previous Operative Measures for Displacement of the Uterus have been carried out.

It is too soon to decide as to the frequency of complications in labor due to the various operations which have been carried out for displacements of the uterus. Only an approximate idea of their relative importance can be given.

Shortening of the round ligaments by all methods has rarely been reported as causing trouble in labor.

Vaginal fixation and ventro-fixation are the most serious causes of trouble, the former more frequently than the latter. Malpresentations and malpositions of the fœtus, inertia uteri, rupture of the uterus, and post-partum hemorrhage are among the most frequent complications. A considerable percentage of obstetric operations have been necessary.

Ventro-suspension is very infrequently followed by difficulty in labor. This is explained by the stretching or breaking of the fibrous suspensory ligaments which support the uterus from the abdominal wall.

New Growths of the Uterus.

1. **Fibromyoma.** Fibromyomata are not common causes of trouble in labor. It is impossible accurately to group the disturbances which occur in relation to the various forms of tumor met with, viz., submucous, subperitoneal, and interstitial.

The most dangerous as regards labor are those in the region of the cervix. These may lead to malpresentations and malpositions of the fœtus, to obstruction in labor, to prolapse of the cord, to adherent placenta, and to post-partum hemorrhage. Labor-pains may be very irregular, often inefficient; sometimes a tetanic condition is met with. Laceration of the uterus may occur. Contusions and fractures of the fœtal skull may be caused. Death may occur in some cases if interference be not carried out.

In the puerperium there is increased risk of inflammation and septic infection, or, in the case of a submucous tumor, of necrosis.

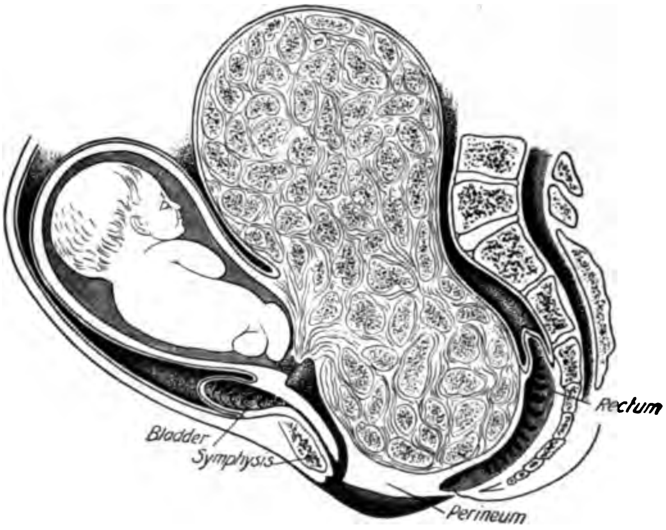
Sometimes the contractions of the uterus may displace above the brim a small tumor which had lain below it on the anterior wall.

Spontaneous enucleation of a submucous fibroid may occur during or immediately after delivery.

DIAGNOSIS. The diagnosis is not, as a rule, difficult, save when the fibroid is on the posterior wall or projecting into the cavity of the uterus. When they can be felt they are generally easily recognized. They may be mistaken for parts of the fœtus, for twins, or for portions of placenta.

TREATMENT. In some cases of fibroid—*e. g.*, subperitoneal ones high up in the body—the labor may go on perfectly naturally. In cases where there are several small fibroids or a large one high up in the wall, the pains may be weak and labor prolonged. In such a case version or forceps may be employed. Interference should be carried out early, because the risks to the mother are greater the longer the delay.

FIG. 295.



Myoma uteri complicating pregnancy. (After SPIEGELBERG.)

When a small tumor is felt so low down as to be a source of obstruction, it should be carefully examined, in order that it may be known whether or not it may be pushed upward. Attempts may be made to push the tumor up, the patient being in the lateral, dorsal, or genupectoral posture. Anæsthesia may be necessary to carry out this procedure. If this is impossible, the further treatment depends on the amount of contraction. It may be so slight that delivery by version or forceps may be performed;

Walcher's position may sometimes assist delivery. If greater, embryulcia or Cæsarean section is necessary. Should such a case be under observation during the course of pregnancy, the induction of premature labor may sometimes be a safe method of procedure.

Polypoidal fibroids of the cervix may be removed before or during delivery. Non-pediculated ones of the cervix may be enucleated artificially.

Where a very large fibroid of the body or several small ones cause marked obstruction, Cæsarean section or Porro's operation should be decided upon.

In all cases in which delivery is effected through the vagina the greatest care must be exercised in the treatment of the third stage. The placenta may be adherent and may require separation. Hemorrhage may be profuse, from the imperfect contraction and retraction of the uterus, or from the opening of vessels in the capsule of a submucous fibroid. The hot intra-uterine douche must be used, as well as hypodermic injections of ergotin. The best method of controlling hemorrhage, however, is to pack the uterus and vagina with sterilized iodoform gauze. This may be left *in situ* for three or four days, and then may be renewed if necessary.

If a submucous tumor tends to become enucleated it should be removed early, in order to diminish the risk of necrosis and suppuration.

It is interesting to note that uterine fibroids often get smaller and sometimes disappear after labor.

2. Carcinoma of the Cervix. This condition may be found at full time, and may be a cause of trouble in labor. Sometimes, if the disease be early and localized, the labor may go on naturally. If the cancer be advanced and infiltrating surrounding tissues, and the case be left to nature, the pains may be intermittent for days, the patient getting weakened, and the child usually dying. Rupture of the cervix may occur, leading to bad hemorrhage or to sepsis.

TREATMENT. If the case is observed during early pregnancy in the localized state of the new-growth, total extirpation of the uterus by the vagina may be carried out. Later in pregnancy premature labor may be induced and amputation of the cervix or extirpation of the uterus afterward carried out, or abdominal extirpation of the uterus may be performed.

At full time, when the cervical cancer is not too extensive, some prefer to perform embryulcia, if a living child cannot be delivered. Opinion is, however, tending more to favor the performance of Cæsarean section in all cases where the disease is at all marked. But whenever there is a chance that the cancer may be entirely removed, Porro's operation should be carried out.

Dührssen has recommended the vaginal route for certain cases. The uterus is drawn down, the bladder dissected from its wall and pushed upward, and an opening made into the uterine cavity, through which the fœtus is extracted. The uterus is then removed.

STENOSIS OF VAGINA AND VULVA AND RIGIDITY OF TISSUES.

Sometimes the vagina may be double, or have longitudinal or transverse septa. Rarely, it may be markedly atresic.

TREATMENT. Septa should be divided. An atresic portion may be dilated if it be not too extensive. Incisions may be necessary. But sometimes embryulcia or Cæsarean section may be indicated.

The hymen may be a cause of obstruction and may require incision or removal.

The vagina and vulva may be narrow and tough in elderly primiparæ, in very muscular women, and in conditions of cicatricial contraction after previous injury.

TREATMENT. Hot douches, emollients, and warm sponges serve somewhat to soften the parts. Dilatation may be promoted by means of artificial dilators—*e. g.*, Barnes's or Champetier de Ribes's bag.[1] If the perineum is so rigid that it will not stretch well, and if a rupture is feared, episiotomy should be carried out with scissors, a cut being made through the edge on each side a short distance from the middle line. This procedure saves the risk of a tear into the anus. The cuts can be closed after delivery, if they are large. It is to be remembered that labor may be expedited in a case of rigid perineum if the patient be placed in Walcher's position.

Where cicatrization of the vagina does not yield to hydrostatic dilatation, accompanied with superficial incisions sufficient to permit of delivery by version or forceps, Cæsarean section is necessary.

SWELLINGS OF THE VAGINA AND VULVA.

Hæmatoma. This condition may be found in the labia, the perineum, or the vaginal walls. Though it mostly occurs after labor, it may be a cause of delay in labor. Sometimes it may form between the delivery of the first and second child in the case of twins. If the mass be large enough to obstruct delivery, it should be incised and cleared out, to allow of the passage of the fœtus. Afterward, if there be slight bleeding, the cavity should be packed with iodoform or chinosol gauze. If, however, the hemorrhage be severe, it may be necessary to close the cavity from side to side with a series of sutures, and to keep up pressure on the surface by means of a pad and bandage. In the case of a small mass delivery may be effected by means of forceps, incision not being necessary.

Œdema of the Vulva. This condition may be due to heart or kidney disease, or to delayed labor. The œdematous parts are apt to tear, and may become gangrenous afterward. Puncture or incision may be necessary, but only when absolutely unavoidable, owing to the risk of sepsis or gangrene. This procedure must be carried out with strict asepsis. Episiotomy may be necessary to save rupture.

Varicose Veins of Vulva. These very rarely interfere with the passage of the head through the vulva. They may rupture or be so bruised as to slough afterward.

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[1] These dilators must not be overdistended, lest rupture of the vagina be caused.

Labial Abscess. If this is large enough to obstruct labor, it may be opened, scraped out, swabbed with iodized phenol, and stuffed with iodoform or chinosol gauze.

Solid Tumors of the Vagina and Vulva. Fibromata and fibromyomata may occur and may interfere with delivery. The bruising of the tumor may lead to after-gangrene.

TREATMENT. If these tumors are not recognized until labor comes on, it may be possible to remove them by enucleation or by amputation of the pedunculated forms. Where this is not considered advisable, forceps may be used if the vagina is not too much contracted. There is danger of causing after-sloughing of tissues if there be a prolonged use of the forceps. Rarely embryulcia or Cæsarean section may be necessary.

Cysts. These may obstruct labor. Puncture is usually sufficient to promote delivery. A pediculated cyst may be removed easily during labor.

Enterocele. Vaginal enterocele may be either anterior or posterior. The latter is most common. The hernial condition may obstruct labor when the bowel is distended with gas or with feces. The long-continued pressure of the head may lead to a rupture of the sac, or may seriously bruise the bowel.

TREATMENT. The patient should be placed in the genupectoral position and the hernia reduced. If this is not possible, owing to the low position of the presenting part of the fœtus, or to adhesions, the child should be delivered rapidly with forceps. Should rupture of the sac occur the intestines should be cleansed and returned, and a repair operation be performed on the posterior vaginal wall.

If the hernial condition be a very large one, Cæsarean section may be justifiable.

Distended Rectum or Colon. Fecal accumulation may delay labor by interfering with the powers and by obstructing the passages. The bowel must be cleared out with enemata or by repeated flushings by means of a funnel and tube. Sometimes it is necessary to scoop out the masses, and for this it may be necessary to anæsthetize the patient.

Sometimes this distention of the rectum may be associated with the condition known as *anus vaginalis,* in which the anus is placed too far forward.

Cancer of the Rectum, if extensive, may be such an obstruction as to lead to Cæsarean section.

CONDITIONS OF THE BLADDER.

Distention. This is a very common cause of delay in labor. The urine should be removed with a long, soft catheter. Sometimes this is impossible, and suprapubic aspiration must be carried out.

Cystocele or Colpocystocele. This condition may obstruct labor. It may be mistaken for an impacted cervix, for the bag of membranes, for the caput succedaneum, or for a tumor.

TREATMENT. The urine should be drawn off, care being taken pass the catheter downward and backward. The prolapsing part shou be gradually pushed up above the advancing head. Sometimes it is nec sary to deliver the child with forceps, the sacculation being held up by an assistant.

Vesical Calculus. If the calculus be very small, labor may go on naturally without causing any trouble, but if it is of any size it is apt to be very painful, to obstruct delivery, and to lead to injury of bladder and vaginal walls. If discovered early in labor it may be pushed above the symphysis and removed after labor, in the case of a small one. Some, however, think it best to remove it by dilatation of the urethra. If the stone be too large to be removed in this way, it should be extracted through a mesial incision in the anterior vaginal wall and base of the bladder. After labor the incision can be closed.

TUMORS OF NEIGHBORING STRUCTURES.

Ovarian Tumors. Ovarian tumors may complicate labor in various ways. If of large size they may interfere with the powers and may obstruct the passages. They may also cause malpositions and malpresentations. Small tumors are serious causes of obstruction when they lie in the true pelvis. Labor may lead to rupture of the tumor when it is cystic, and this may be followed by intra-peritoneal hemorrhage or peritonitis; or the tumor wall may be much bruised and inflammation and adhesion may result. Twisted pedicle and occlusion of the bowels are sometimes caused. Rupture of uterus, vagina, or rectum may occur.

DIAGNOSIS. This may be difficult in some cases. The tumor may be mistaken for a fibroid or for a blood or inflammatory exudation when it is situated within the true pelvis. When it is cystic and fluctuation can be made out by vaginal examination, the diagnosis is easier.

When the tumor is above the brim and is not situated behind the uterus it may be felt distinct from the uterus, and may be moved unless impacted or fixed by adhesions. The abdomen is exceptionally distended, and the condition may be mistaken for hydramnios or twins. However, no intermittent contractions occur in the wall of the tumor, and it is thus distinguished from the uterine wall.

TREATMENT. If the woman has begun labor and the tumor be below the brim, an effort should be made to push it into the abdomen, anæsthesia being used, if necessary. If this fail, some authorities think it best to try delivery with forceps, if the obstruction be not too great; or, if this fail, to tap the cyst and deliver with forceps, or to employ embryulcia. Others reject these measures, and recommend abdominal section and removal of the tumor; or, in some cases, Cæsarean section and removal.

The objection to vaginal puncture is that it may be followed by danger to the peritoneum by escape of the contents, especially if it be a dermoid. If the cyst contain many loculi, puncture may do no good. Also, a mistake in diagnosis may be made, and a pyosalpinx, for instance, might be opened.

When the cyst is above the brim delivery may usually be effected by version or forceps.

Other Tumors of the Soft Parts. Broad ligament, tubal, and other swellings, if of sufficient size to cause serious obstruction in labor, are best treated by Cæsarean section. A hydatid cyst should also be treated in this way.

Inguinal and Crural Herniæ. These may be forced down during labor and cause a great increase in pain and excessive straining. It may be necessary to hold the hernia back during the pains, or sometimes to anæsthetize the patient and deliver by version or forceps.

Floating Kidney. A kidney may be displaced downward and be adherent at the brim, or may be deeply placed in the pelvis, causing an obstruction and increasing the patient's suffering greatly. It may be necessary to anæsthetize and deliver by version or forceps.

Runge performed abdominal section in one case, raising the kidney out of the pelvis. Albers-Schönberg reports one case in which rupture of the uterus was caused. In another, in which the kidney lay in the pouch of Douglas, vaginal nephrectomy was carried out; this was followed by successful labor.

Tumors of the Liver. Large hydatid cysts and carcinomatous tumors may obstruct labor. Version or forceps may be necessary, or Cæsarean section.

3. ANOMALIES OF THE FŒTUS.

Malposition of the Head.

OCCIPITO-POSTERIOR CASES.

There are two varieties: that in which the long axis of the head lies in the right oblique diameter at the beginning of labor—right occipito-posterior, R. O. P.—and that in which it lies in the left oblique diameter—left occipito-posterior. The former is the more common.

Labor is generally longer in these cases, partly because the head does not flex well on entering the pelvis, and so does not become well accommodated to it, and partly because of the long internal rotation. The pains in the first stage are often irregular and imperfectly marked.

DIAGNOSIS. On external examination of the abdomen at the beginning of labor, the back of the fœtus is not felt through the mother's anterior abdominal wall. If the parts are lax or thin, the irregular projections of the limbs of the fœtus may be felt. The head may be palpated above the brim. The fœtal heart is heard well around in the flank between the iliac crest and the ribs. On vaginal examination the rounded head is felt through the fornices. When the cervix is opened sufficiently to allow the entrance of the fingers, the sagittal suture is felt in the line of the oblique diameter, and the posterior fontanelle is in the posterior half of the pelvis.

MECHANISM. The normal mechanism in a typical case is as follows:

Flexion.
Internal rotation.
Extension.
External rotation.

Flexion goes on slowly, and consists in a movement of the occiput downward and inward from its original position near the girdle of contact. Following this movement, the occipital end of the head reaches the sacral segment of the pelvic floor. As a result of this, according to the teaching of Berry Hart, internal rotation is brought about, the occiput being thrown or directed forward until it lies in the middle line anteriorly. The rest of the delivery proceeds as in an occipito-anterior case.

FIG. 296.

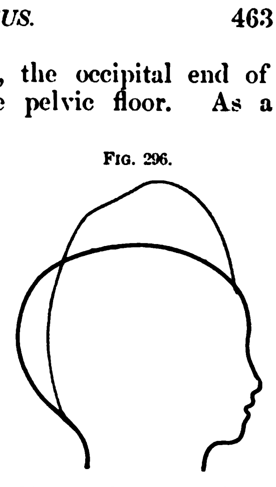


Diagram showing head unmoulded and moulded in a persistent occipito-posterior case.

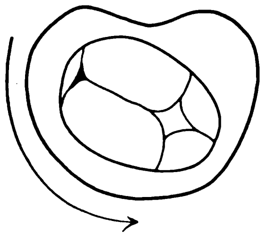
Black, unmoulded.
Red, moulded.

Abnormal Occipito-posterior Cases. 1. In some cases the head does not flex well on entering the brim, owing to a small size of the head. The sinciput reaches the sacral segment of the pelvic floor before the occiput on the opposite side, and as a result, according to Hart's law, it is rotated to the front of the pelvis, the occiput turning into the hollow of the sacrum. Clinically, we always speak of this malrotation as a rotation of the occiput to the back; but in reality, according to Hart, the essential feature is the anterior rotation of the sincipital end of the head.

The head may now remain in this position, which is termed "Persistent Occipito-posterior" or the "Face to Pubes" case.

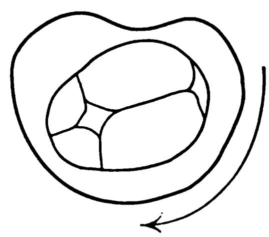
But natural expulsion may take place, the face passing under the symphysis and the occiput over the perineum. This is accomplished with difficulty, and requires very strong pains, lax maternal parts, and not too large a head. The perineum is generally badly torn. The head flexes well before it passes through the outlet. After the birth of the head external rotation (really an internal rotation of the shoulders) occurs, and the body is born.

FIG. 297.



Right occipito-posterior position of head. The arrow shows the direction of the long internal rotation made by the occiput in delivery.

FIG. 298.



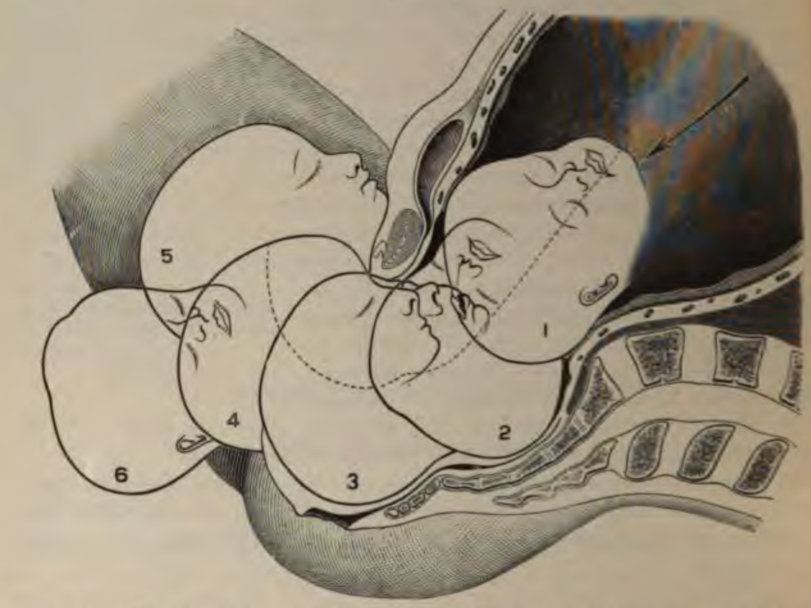
Left occipito-posterior position of head. The arrow shows the direction of the long internal rotation made by the occiput in delivery.

The *head-moulding* in these cases is as follows: The occipito-mental and occipito-frontal diameters are much shortened, the suboccipito-bregmatic being lengthened greatly.

2. In some cases, owing to the disproportion between the occipital end of the head and that part of the brim in relation to it, flexion is prevented, and the head may enter the brim in an extended position, giving a brow or face presentation.

3. In another set of cases the head may enter the brim poorly flexed, and on reaching the pelvic floor may rotate only partially, remaining fixed in its long diameter, being in the transverse of the pelvic cavity.

FIG. 299.



Faulty mechanism in a right occipito-posterior case. The occiput is shown rotating to the back. (After SCHULTZE.)

MANAGEMENT OF LABOR. The case should be carefully watched and frequent examinations should be made to determine whether or not flexion is taking place to a sufficient extent. If the mechanism goes on satisfactorily, the management is the same as in an occipito-anterior case.

When flexion takes place badly it should be promoted, the sinciput being pushed up during the pains. This is best accomplished if the patient be placed in the genupectoral posture.

If this be not successful, some authorities recommend that the woman be anæsthetized, the hand passed into the cervix and the head markedly flexed by pressing up the sinciput. The anæsthetic should then be stopped and the head kept flexed until pains return, forcing it into the brim. Should extension again be established, the following methods may be adopted: The fœtus may be turned and delivered as a breech case; or the head and trunk may be rotated by the hand until the occiput is anterior, and then may be delivered with forceps; or forceps may be at once applied while the occiput is posterior. Most physicians employ the latter method.

APPLICATION OF FORCEPS IN A HIGH OCCIPITO-POSTERIOR CASE. The blades are applied in the ordinary manner—*i. e.*, right and left qua the pelvis. As the head is drawn into the cavity rotation tends to occur.

As a result of this the blades are so altered as to be ill-adapted to the pelvic curve, and they should, therefore, be removed as soon as the head is well through the brim. The case may then be left to nature, or the forceps may be reapplied.

Recently Milne Murray has introduced axis-traction forceps for these cases to allow of continuous extraction of the head in spite of the rotation which occurs. The main feature which allows of this is the lessening of the curve of the blades.

APPLICATION OF FORCEPS WHEN THE HEAD IS LOW IN THE PELVIS. When the occiput has not rotated to the front or has only partly rotated, the forceps will grasp the head obliquely or antero-posteriorly. As traction proceeds the head tends to rotate. If this is marked, the blades should be removed and reapplied. Between tractions the handles should be separated, because sometimes the occiput tends to turn to the front spontaneously.

When the occiput is in the hollow of the sacrum the sinciput should be kept well pushed up, in order to promote flexion and to allow head-moulding to occur. Then forceps should be applied and delivery brought about, the patient being placed in Walcher's position the better to protect the perineum. As the head emerges it should flex, the root of the nose pivoting under the pubic arch.

If necessary, the perineum should be incised on each side of the middle line to prevent a central rupture.

FACE PRESENTATIONS.

FREQUENCY. Face presentations are not common. Various statistics are given, from 1 in 200 to 1 in 497.

POSITIONS. The chin is the denominator and the positions are in order of frequency:

Right mento-posterior, R. M. P.
Left mento-anterior, L. M. A.
Left mento-posterior, L. M. P.
Right mento-anterior, R. M. A.

Some authorities believe that left mento-anterior positions are more frequent than right mento-posterior.

ETIOLOGY. It is best to regard face presentations as altered vertex presentations. They very rarely exist before labor sets in, and, as a rule, they develop only as labor proceeds. The causes are varied; they may be tabulated as follows:

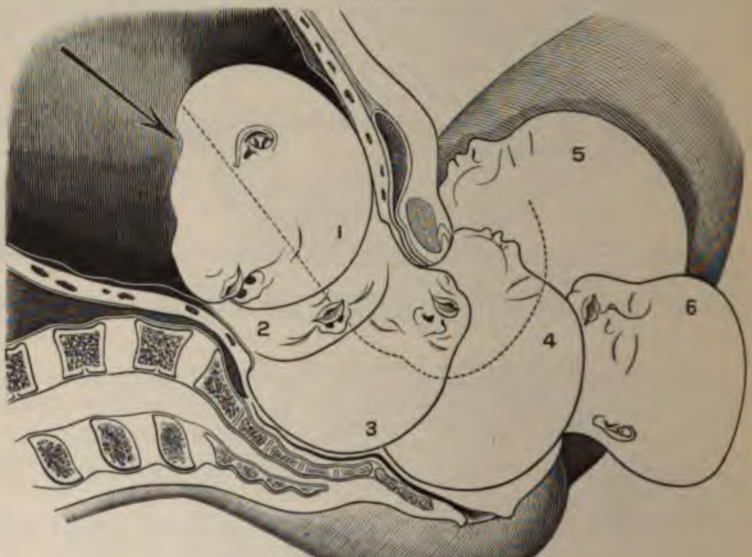
1. Enlarged neck or thorax—*e. g.*, due to tumor.
2. Coiling of cord around neck.
3. Folding of arms under chin.
4. Excessive mobility of fœtus.
5. Small size of fœtus.
6. Excessive liquor amnii.
7. Obliquity of uterus.
8. Sudden escape of liquor amnii.
9. Flat pelvis.
10. Certain conditions of occipito-posterior cases, in which there is a tight fit at the brim.

By some, dolichocephalic head is given, but it is doubtful if this shape ever exists in utero sufficiently marked to bring about a malpresentation. It is found after delivery in face cases, but the shape is due to the head-moulding.

The factor in changing a vertex to a face presentation is evidently extension, and the student may easily understand how the above causes may induce this change.

DIAGNOSIS. The examination of the mother's abdomen reveals, in many cases, nothing different from what is found in a vertex presentation. If the abdominal wall be lax, however, it may be possible to feel the furrow between the back and the occiput, owing to the extension of the head. There is also a lack of application of the body of the fœtus to the uterus and abdomen. The bulging of the occiput at the side may be felt. On vaginal examination early in labor the rounded head felt in vertex cases is wanting. The fornix is high up and somewhat irregularly flattened across.

FIG. 300.



Mechanism of labor in a face case. Right mento-anterior. (After SCHULTZE.)

When the cervix is somewhat dilated, forehead, nose, malar processes, and mouth may be distinguished. If much of a caput succedaneum has formed over the face, it may be mistaken for a breech; the mouth being mistaken for the anus, the nose for the coccyx, the malar processes for the ischial tuberosities, and the cheeks for the nates. Care must be taken not to injure an eye in making the examination.

PROGNOSIS. Labor is slow. The first stage is delayed because the head does not fit so well in the lower uterine segment as in a vertex case, and does not allow of the formation of so good a bag of waters. Anterior cases—*i. e.*, those in which the chin is in front, are better than posterior, and the labor is quicker.

In posterior cases malrotation may occur, usually requiring interference; the skull is compressed against the pubes. The maternal risk is not greatly over the normal; the risk to the child, compared with vertex cases, is computed to be as 13 is to 5. There is more danger of laceration of the perineum.

MECHANISM. *Normal.* (*a*) In the most common anterior case—L. M. A. (this is simply an R. O. P. case in which extension of the head has occurred). At first extension of the head goes on slowly, and it passes through the brim with its vertical diameter in relation with the inlet. As the fœtus is pushed down it is evident that that part of the head which first reaches the sacral segment of the floor is the chin. It reaches the anterior part of the left half of the segment, and, in accordance with Hart's law, is rotated forward to the middle line under the symphysis. When internal rotation is complete, flexion follows. The mouth, nose, eyes, and forehead appear successively. Then the vertex comes over the perineum while the chin slides forward under the symphysis. Finally the occiput sweeps over the perineum. Afterward external rotation or restitution occurs—in reality a rotation of the shoulders—and the body is next delivered.

(*b*) In the most common posterior case—R. M. P. (this is an L. O. A. in which extension has occurred), at first extension of the head occurs. Long internal rotation then takes place, whereby the chin is brought to the front under the symphysis. The rest of the labor is the same as in the case of L. M. A.

Abnormal. (*a*) In a large pelvis, sometimes, or in cases where the fœtus is small, the head may be pushed through the pelvis without any special mechanism.

Its long diameter may be found in relation with any diameter of the pelvis. In the flat rachitic pelvis it usually passes with its long diameter in the transverse. These abnormal deliveries are most favored by death of the fœtus, when its tissues become more lax.

(*b*) Sometimes, in mento-posterior cases, abnormal internal rotation occurs, so that the chin, instead of being carried to the front, is turned to the hollow of the sacrum. According to Hart, the explanation of this condition is as follows: It only occurs when the pelvis is very large or the head small. Extension of the head is imperfect, and the chin does not strike the sacral segment on its own side. It is the sinciput which strikes the opposite segment, and is, therefore, rotated to the front. In other words, that which we describe clinically as a rotation of the chin to the back is really a forward movement of the sinciput.

FIG. 301.

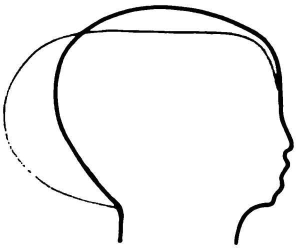


Diagram showing head unmoulded and moulded by labor in a case of face presentation.

Black, unmoulded.
Red, moulded.

This condition is a bad one. It is very rare that natural delivery follows, and then only when the head is very much smaller than the pelvic cavity. It is apt to become arrested, being then known as a "persistent mento-posterior" case. The reason of this is evident. The chin is jammed in the curve of the sacrum, and if the head is to be born the coccyx must be excessively bent back, the sacro-sciatic ligaments and perineum greatly stretched, and the cranial vault greatly flattened.

HEAD-MOULDING. After an ordinary face delivery the vault of the head is seen to be flattened, the supra-occipital being pushed backward and the convexity of the frontals increased. The transverse, occipito-frontal, and occipito-mental diameters are increased, the suboccipito-bregmatic lessened.

The caput succedaneum is found on the face: in mento-posterior cases in the upper malar region and region of the eye (thus, in the R. M. P. case, on the right side of the face); in mento-anterior cases in the lower malar region, about the angle of the mouth (thus in L. M. A., on the left side of the face). In other words, the caput is formed over that part which has been especially placed in relation to the deficiency in the anterior pelvic wall below the pubes. The skin may be greatly discolored. The eye may be closed for some days, or the mouth may be incapable of suckling for a short time.

MANAGEMENT. The bag of membranes should be preserved as long as possible, because the face is so poor a dilator. Sometimes the case may be left to nature—*i. e.*, when the woman is a multipara who has had easy labors, when the pelvis is roomy and the soft parts easily dilatable, when the pains are good, and when the chin is anterior.

Internal rotation may be favored by the turning of the chin forward with the fingers during the pains.

In posterior positions of the chin, or in anterior positions when any abnormal condition exists, interference is necessary.

Different procedures are recommended. At first the patient should be anæsthetized and an effort made to bring about a vertex presentation by external manipulation through the anterior abdominal wall. But if this procedure fail, the following means may be tried.

When the chin is posterior an attempt may be made, first of all, to restore a vertex presentation by pushing up the sinciput. When the chin is anterior this would only result in an occipito-posterior position, and, therefore, it is not to be recommended. If restoration is carried out and the vertex engages, the case may be left to nature; if engagement does not soon take place, forceps should be applied.

If restoration of the vertex presentation be not possible or advisable, delivery by version may be employed. If version be impossible or dangerous, owing to the conditions present, forceps may be used in anterior positions. This is a difficult and dangerous mode of treatment, and is only to be undertaken as a last resort. The grip of the blades is bad for the child, and also for the mother, on account of the width between them. When the chin is posterior they should not be used at all, because if the head passes the brim, it tends to move, so that the chin goes into the hollow of the sacrum.

When delivery is impossible by these procedures, embryulcia is justifiable.

When the head has passed the brim and tends to be delayed, in spite of the efforts to promote extension and internal rotation, there is always danger to the child from the tension on the vessels of the neck and from the pressure against them, endangering the cerebral circulation. In such a case forceps should be employed. They must be used carefully, as there is great risk that the blades may press dangerously on the nerves and vessels of the neck.

When the chin has rotated into the hollow of the sacrum, efforts should be made to rotate it to the front, the patient being anæsthetized, if necessary. If this is impossible, the usual plan is to attempt delivery with forceps. When the head is passing the perineum the latter should be incised on each side to lessen the risk of bad laceration, and the patient should be in Walcher's position. As soon as the chin is born the rest of the head should be brought out by flexion. If this method of delivery be impossible, or if the child be dead, embryulcia may be performed. Recently, however, owing to the success of symphyseotomy, it is strongly recommended that in a persistent occipito-posterior case this operation should be performed before delivery is attempted with forceps. There is far greater chance of getting a living child, and the risk to the mother is not much increased.

BROW PRESENTATIONS.

FREQUENCY. Brow presentations are very much less frequent than face cases. They are only a half-way stage in the development of the latter, the head being only partially extended. The most frequent position is that in which a vertex L. O. A. has been changed; the next most frequent that in which a vertex R. O. P. has been altered.

ETIOLOGY. The causes are the same as in the case of face presentations.

DIAGNOSIS. By external examination the condition cannot be made out. When labor has begun and the fingers can be passed within the cervix, the root of the nose, the margins of the orbits, and, possibly, the anterior fontanelle, may be felt.

MECHANISM OF LABOR. 1. In certain cases where the child's head is rather small a special mechanism may take place. The head passes through the brim in the extended position, the occipito-mental diameter having been diminished in length. The brow descending to the pelvic floor is then rotated to the front until it lies opposite the vulva, the face being behind the pubes and the chin at its upper margin; the occiput lies in the hollow of the sacrum. Flexion then occurs, the cranial vault sweeping over the perineum; the nose, mouth, and chin afterward passing under the symphysis. The body is then born, rotation taking place for the delivery of the shoulders.

2. Sometimes, when the pelvis is very large or the child small, the latter may be pushed through the pelvis without any mechanism.

3. A natural change in the presentation may take place to a vertex or to a face.

HEAD-MOULDING. After the mechanism described above, the head is characteristically altered. The caput succedaneum reaches from the root of the nose to the anterior fontanelle, the forehead is somewhat perpendicular, and the parietal and occipital bones slope downward and backward. On profile the head has thus a somewhat triangular shape.

In a case which has begun as a brow and finished as a face, the head is dolichocephalic, with a marked caput succedaneum on the forehead and one on the face.

MANAGEMENT. On diagnosing a brow case early in labor the sinciput should always be pushed up, in order to bring about an engagement of the vertex, pressure being made during the pains. The case may then be left to nature, or forceps may be used. If the vertex presentation cannot be produced successfully, and if the case be one in which the brow position is posterior (*i. e.*, in which originally the occiput was to the front), delivery by version should be proceeded with. It is not wise to change the presentation to that of a face in this condition, because the chin will be made to lie posterior. If, however, the case be one in which the position is anterior, instead of performing version some prefer to bring about extension to the head, and so to get a face presentation, the chin being to the front. The case may then be left to nature, or may be treated in the various methods recommended for face presentations.

FIG. 302.

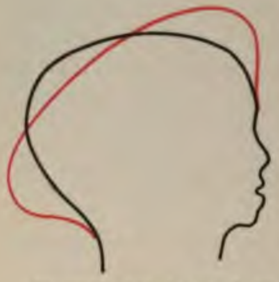


Diagram showing head unmoulded and moulded by labor in a case of brow presentation.
Black, unmoulded.
Red, moulded.

When these procedures cannot be carried out, and labor is delayed, it may be necessary to attempt delivery with forceps, a procedure which is unfavorable both for child and mother. When this is impossible or too dangerous, embrylucia may be performed.

Now, however, it is highly probable that symphyseotomy will displace both the use of forceps and embryulcia in these cases.

When labor is delayed after the head has entered the pelvis, forceps is indicated. When malrotation has occurred and the chin is posterior, the use of forceps is difficult and dangerous, and the case must be treated practically as one of persistent mento-posterior face.

PELVIC PRESENTATIONS.

FREQUENCY. According to the statistics of Pinard, pelvic presentations occur in the proportion of one in thirty labors; excluding miscarriages and premature births, however, he finds it to be about one in sixty. In the majority of cases the breech presents; in the rest either the knees or the feet present.

The positions in order of frequency are :

Left sacro-anterior, L. S. A.
Right sacro-posterior, R. S. P.
Right sacro-anterior, R. S. A.
Left sacro-posterior, L. S. P.

The denominator is the sacrum.[1]

ETIOLOGY. The conditions favoring a pelvic presentation are exce sive liquor amnii, lax uterine and abdominal walls, obliquity of t uterus, multiparity, multiple pregnancy, monstrosity, death or prem turity of fœtus, placenta prævia, contracted pelvis, tumors of uterus or neighboring structures.

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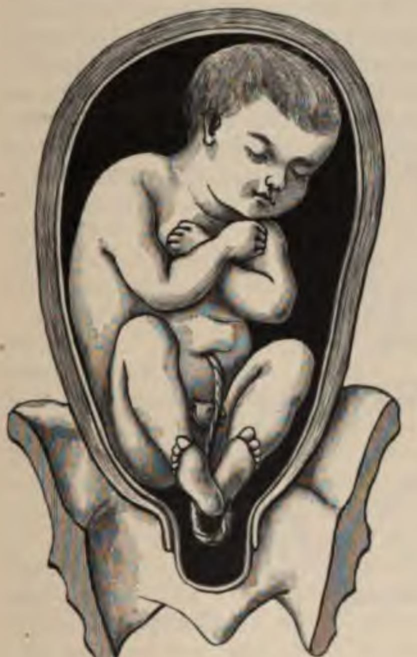
[1] Berry Hart objects, rightly, to the use of the sacrum as the denominator. We do not follow th sacrum in the mechanism of labor, but the hip which is nearest the front. Therefore, to keep u uniformity of description in the various mechanisms, he desires to denominate the positions in reference to the hip.

DIAGNOSIS. On abdominal examination, the head is felt in the upper part of the uterus. The fœtal heart-sounds are heard above the level of the umbilicus.

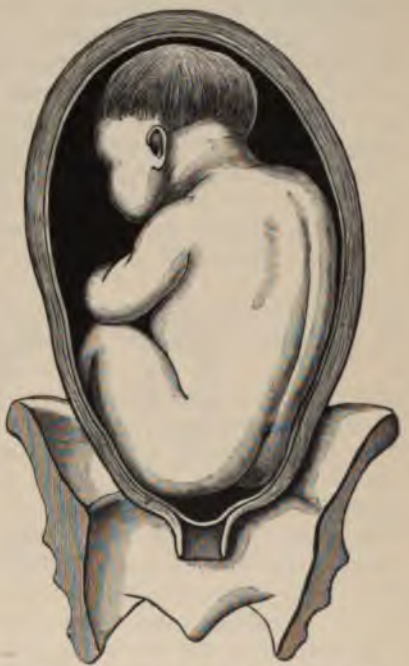
On vaginal examination, early in labor, the hardness of the head is missed through the fornices. After labor has advanced the examining fingers may recognize through the cervix, the sacrum, coccyx, and ischial tuberosities. The anus is felt as a dimple below the skin level. If the child is dead, however, it may be gaping and may project as an eminence.

FIG. 303.



Breech presentation. Right sacro-posterior. Feet and cord in relation to os internum. (After A. R. SIMPSON.)

FIG. 304.



Pelvic presentation. Left sacro-anterior position. (After A. R. SIMPSON.)

If the child be a male the penis and scrotum may be felt; the latter should not be mistaken for the bag of membranes. The finger should be passed into the groin, which is distinguished from the axilla by the absence of ribs. Movements of the feet are felt when the case is a footling presentation. The foot must be distinguished from the hand by the presence of the projecting heel and by the parallel toes.

The feet usually lie close together. The knee is distinguished from the elbow by the presence of the patella, by its larger size, and by the absence of the sharp olecranon.

Meconium may be distinguished in the vaginal discharge. It is abundant and tarry, not in flakes.

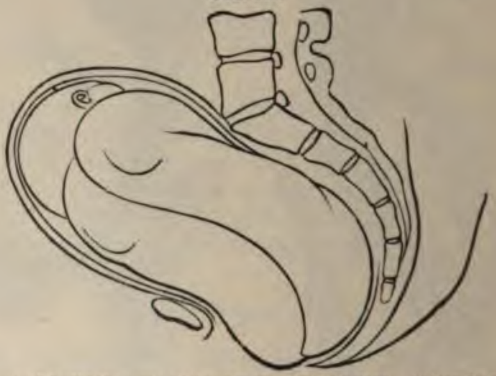
A breech may be mistaken for a face (see page 466).

PROGNOSIS. In cases which are uncomplicated the maternal risks are no greater than in vertex cases. The risks are those of interference. They are laceration of the cervix and perineum, inertia of the uterus from too rapid delivery or from loss of blood, separation of placenta from too rapid delivery.

The risks to the child are great, the mortality being about 1 in 10. These are due to prolapse of the cord and pressure on it; early escape of the liquor amnii, which is apt to occur, because the girdle of contact does not grasp the breech as well as it does the head, and, the forewaters not being completely shut off from the rest of the liquor amnii, the membranes burst under an abnormal degree of the force of uterine contraction; partial or complete separation of the placenta from hurried delivery or prolonged compression of the placenta, leading to gradual asphyxia or to sudden death. Fractures and dislocations may be caused by interference. It is stated by Koettnitz that hæmatoma of the sterno-mastoid and torticollis are most frequent in connection with breech delivery.

MECHANISM. The normal mechanism usually takes place as follows: The breech is either pushed straight down through the pelvis, or the anterior hip may descend somewhat in front of the other. This hip on reaching the sacral segment of the pelvic floor is rotated to the middle line in front, this movement being known as internal rotation. It becomes fixed at the pubic arch, while the trunk is more driven down into the pelvis and the posterior hip moves forward to the perineum, which gradually retracts over it. The anterior hip is then somewhat released from being pressed against the pubic arch, and the whole pelvis moves onward, followed by the rest of the trunk, with the lower and upper extremities, both being in an attitude of flexion. Sometimes the lower limbs are not bent at the knees, but lie straight on the front of the body. This is less favorable, and may cause delay in labor, because the straight limbs act as splints, as Tarnier has stated, interfering with the flexing of the trunk and with its accommodation to the pelvic curve. The shoulders pass the brim, their long diameter in the transverse. The head passes flexed, its antero-posterior diameter lying in th

FIG. 305.



Passage of buttocks over perineum in a breech case. (After BARNES.)

oblique or transverse of the brim. When it is well in the cavity rotation occurs, so that the occiput turns to the front, the face being in the sacral hollow. The face and the forehead are then born, followed by the rest of the head.

MOULDING OF THE FŒTUS. The breech is swollen. It may be only œdematous, or may present a large, dark swelling. This is generally over the anterior hip, but it may spread to the region of the genitals, and may especially affect the scrotum in the male. These signs may also be found in the knees or feet when they present.

ABNORMALITIES IN THE MECHANISM. 1. The breech may stick at the brim and may not engage. This is especially apt to be the case where the pelvis is contracted.

2. Having entered the brim the body may stick, no further advance being made. This condition of matters may be due to the small size of the pelvis, abnormal size of the fœtus, contraction of the cervix, or to the extended position of the limbs on the anterior surface of the fœtus.

3. The arms may be displaced upward, one or both being in front, behind, or at the sides of the head. This may be due to contraction of the cervix on the body above the pelvis of the fœtus as it descends, or to the small size of the pelvis; but it is important to note that it may follow too hurried emptying of the uterus when there is artificial delivery. Very often, when the lower limbs are displaced, the upper limbs are apt also to be displaced.

This condition causes a delay in labor, which usually requires special treatment. The life of the child is endangered from the extra risk of pressure on the cord.

4. The head may become impacted above the brim or in the pelvic cavity. This usually happens as a result of extension from too rapid delivery of the child. In other cases, where the pelvis is relatively large, and the sacrum directed toward the back, the anterior hip may not turn to the front, but the body of the fœtus passes straight through the pelvis, the shoulders passing the brim in relation with the transverse diameter. The head may descend and normal rotation of the occiput take place. But rotation may not occur, the occiput remaining in the hollow of the sacrum.

In some of the cases in which the head gets extended at the brim the chin is apt to catch above the pubes and to delay labor.

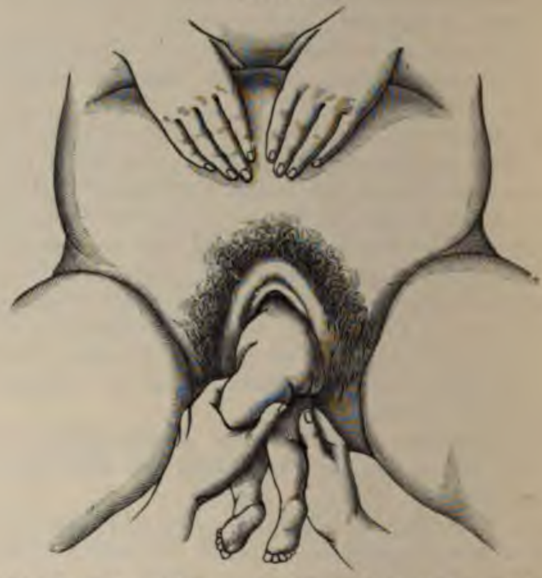
In cases, also, where the back of the fœtus is to the front the head may stick above the brim if extension occurs.

In the pelvis the head may also stick in the transverse from incomplete rotation, or in the antero-posterior diameter, the occiput being to the front, owing to extension of the head having caused the chin to get fixed in the sacral hollow.

GENERAL MANAGEMENT. No attempt should be made to alter the presentation, nor to interfere as long as labor progresses naturally. The physician should watch the case more closely than in a normal vertex case, and should have skilled assistance within easy reach. Dilatation of the cervix may be promoted by means of hot douches. But if the membranes have been driven down as a sausage-like pouch, or have ruptured early, Champetier de Ribes's or Barnes's bag may be used, and nature may be allowed to expel the pelvis and lower extremities. When the umbilicus appears, a piece of cord is pulled down and examined. If it is pulsating well, nature may be allowed to continue the delivery. The exposed parts may be protected with a warm cloth and held up from the perineum.

When the hands appear they may be freed. If it is found that pulsation in the cord be feeble or has just ceased, it is necessary to hasten delivery.

FIG. 306.



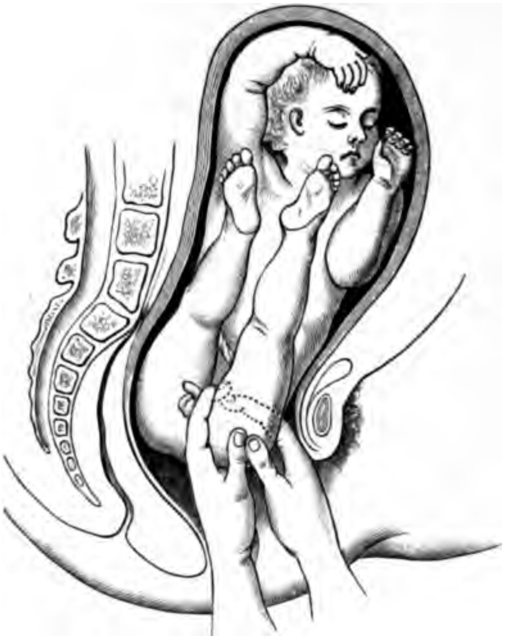
Delivery of child in a breech case by pressure on fundus uteri and by traction on lower limbs. (After A. R. SIMPSON.)

Another indication in the same direction is spasms of the body due to respiratory efforts. Speedy delivery is attained by *suprapubic pressure on the uterus*, accompanied with traction from below. Of very great importance is the former of these. The traction should be made in the axis of the pelvis, at first well backward against the perineum.

Sometimes the cord passes between the legs of the child. In such a case a loop should be pulled down and slipped up over the posterior thigh. If this be impossible, or if the cord is wound around the body, it should be doubly ligatured and divided. Then delivery should be hastened.

MANAGEMENT IN SPECIAL CONDITIONS. *Non-engagement at the Brim.* When the breech does not engage in the brim, a lower limb should be brought down, provided there be no undue contraction of the brim. The case may then be continued by nature; but if the patient be exhausted, slow artificial delivery should be carried on by means of pressure from above the pubes and by traction from below. The latter manœuvre should be carried out as follows: The foot should be grasped between the first and second fingers. The other foot need not be brought down unless it is bent over the child's back or crosses the other leg. The limb should be drawn down slowly and by stages. When the leg is beyond the vulva it should be covered in a warm cloth and held by the whole hand. In pulling no marked friction against the pubic arch should occur. As the child descends it should be grasped close to the mother's vulva. When the breech reaches the perineum the traction should be more in the axis of the outlet. As the lower part of the abdomen appears the other leg usually falls out. The rest of the delivery should imitate the natural process.

FIG. 307.



Delivery of child in a breech case by traction made with fingers placed in groin. (After A. R. SIMPSON.)

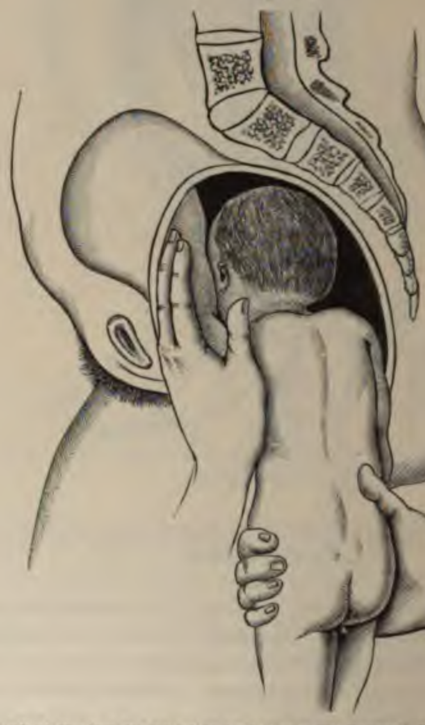
Impaction of the Breech. When, having entered the pelvis, the breech sticks, various procedures may be adopted. Here it is impossible to pull down a limb safely. The index-fingers hooked into the groin may be sufficient to promote descent by traction. Better, however, is a fillet, such as a soft piece of silk cloth. An aseptic gum-elastic catheter threaded with a loop of string may be used to pass the fillet around the groin. A blunt hook is also sometimes used for the purpose of extraction, but is apt to cause injury. The line of traction should be toward the side on which the sacrum lies, in order that fracture of the thigh may be avoided.

Forceps may also be applied to the breech in such a case, though not without some difficulty.

Sometimes delivery by these means is impossible, and embryulcia is necessary, a grip being obtained with a cranioclast, or crushing of the pelvis being performed with a cephalotribe. The after-coming head should also be perforated in such a case to render its passage more easy and to insure death of the child.

Upward Displacement of the Arms. (*a*) When the head is still above the brim. When the brim does not allow the passage of the head and arms, jamming occurs just about the period when the tips of the scapulæ appear at the vulva. It is then necessary to free the arms. The body of the fœtus should be pushed a little upward in order to diminish the pressure on the arms at the brim, and the child's body should be rotated until its back is directed toward one or other side of the mother. It should then be pressed well forward against the symphysis, in order that an attempt may be made to free the arm which is most posterior. The hand is passed upward into the hollow of the sacrum and the first two fingers along the side of the neck behind the posterior arm as far as the elbow. The latter should then be swept over the face and thorax until it comes to lie within the pelvic cavity. The body of the child is then pressed backward against the perineum, and an attempt made to bring down the anterior arm by a proceeding similar to that employed in the case of the other one. Sometimes it is impossible to get room enough to carry out this latter procedure. In such a case the body of the child should be carefully rotated by both hands placed on the thorax, the back of the child moving across the front of the mother's pelvis. The thorax should be well pushed up when this manœuvre is begun, in order [illegible] diminish the risk of dislocating the neck. By this rotation of the bac[illegible]

FIG. 308.

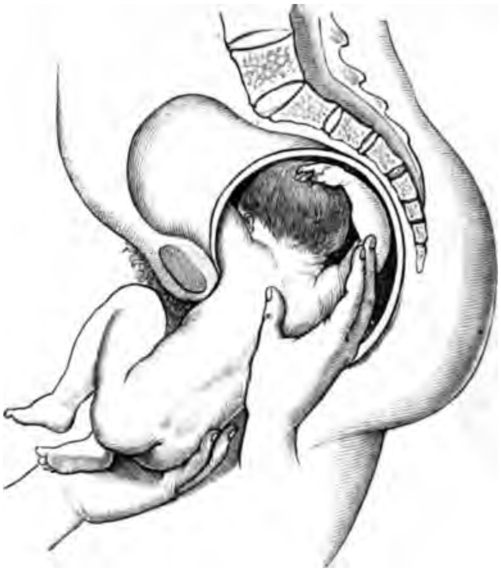


Method of freeing the anterior arm displaced upward in a breech delivery. (After A. R. SIMPSON.)

of the child from one side of the mother's pelvis to the other, the arm which was anterior is made to lie posterior, and then it may be more easily drawn down.

(*b*) When the head is below the brim. The release of the arms in this position is much easier than when placed above the brim. The procedure is practically the same. The trunk should first be drawn down as far as possible. Usually the posterior arm is first brought down; but the best rule is to release that one which is most accessible, the child's trunk being directed well toward the mother's pubes or perineum, as the case may be.

FIG. 309.



Method of freeing the posterior arm displaced upward in a breech delivery. (After A. R. SIMPSON.)

In some cases an arm gets jammed over the back of the head between the occiput and the pelvic wall. In freeing it the fingers should be passed up over the back of the fœtus, and the arm carefully pushed around the side of the head to its own side. The elbow may then be drawn down over the face and thorax. Sometimes the arm in such a case may be released from its dorsal position by rotating the body in the opposite direction from that which caused the trouble.

In all these manipulations on the arms there is danger of dislocating the shoulder-joint, of separating the epiphysis at the upper end of the humerus, of fracturing the humerus, clavicle, or spine of the scapula, or of injuring nerves. The traction should, therefore, be made in the bend of the elbow.

In cases where this method fails, division of the clavicle may be performed—cleidotomy—to diminish the size of the shoulder-girdle.

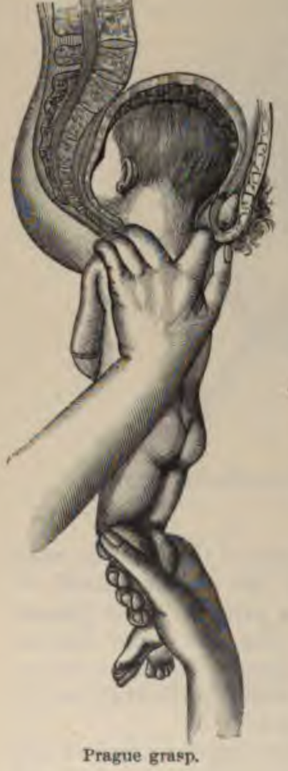
Constriction of the Head by the Uterus. Sometimes the retraction ring of the uterus may grasp the head tightly; sometimes the cervix may be closely retracted on the neck. This condition greatly endangers the life of the child, and delivery must be rapid. The patient should be deeply anæsthetized, and traction made on the shoulders and mouth, or forceps should be applied.

Impaction of the Head. This may take place at the brim or in the pelvis. It may be due to the large size of the head or small size of the pelvis, or to some other form of obstruction. It may also be caused by the extension of the head when there is a want of suprapubic pressure. Generally, however, it is due to extension of the head, brought about by traction on the fœtus unaccompanied with suprapubic pressure.

The methods of delivery employed in these cases are:

1. Manual Extraction. (*a*) *By the Smellie Grasp.* The body of the child is covered in a warm cloth and is placed on the flexor aspect of the physician's forearm, the legs hanging down, one on each side. The fingers of this hand are passed into the vagina, the first and second fingers being placed in the fossæ on each side of the child's nose. The fingers of the other hand are then passed up over the back as far as the occiput. By pulling down with the fingers that are on the face, and pushing up with those of the other hand, the head is flexed. Then, by raising the trunk, the head is born and the face is delivered over the perineum.

Fig. 310.



Prague grasp.

(*b*) *By the Prague Grasp.* Some physicians prefer this grasp. One hand grasps the feet, by which the body can be drawn well back over the mother's perineum. The fingers of the other hand are hooked over the shoulders, and then traction is made downward by both hands, the body being gradually carried toward the pubes as the face is drawn over the perineum.

(*c*) *Smellie-Veit or Mauriceau Method.* This is the combined method of traction on the lower jaw and shoulders. The first two fingers of the hand that is in relation to the anterior aspect of the child are placed in the mouth, while the fingers of the other hand grasp the shoulders. The child is first draw downward, and then the body is carried t ward the pubes, while the face sweeps o the perineum.

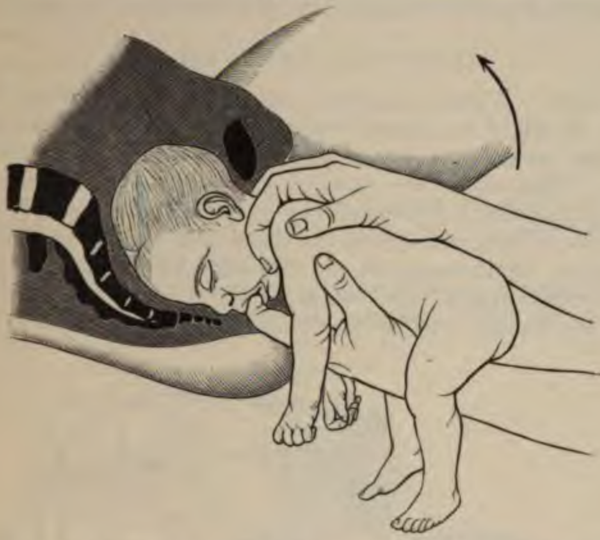
Care must be taken not to fracture or dislocate the lower jaw.

(*d*) *Wigand-Martin Method.* One hand is used with the fingers o the shoulders astride the neck to extract the child, while the other pres the head down from above the pubes.

2. Forceps Extraction. When the foregoing methods fail, force may be used. They are chiefly serviceable when the perineum is ve rigid and when the head is arrested at the brim. In applying the blad the body of the fœtus should be carried well against the pubes. Whe

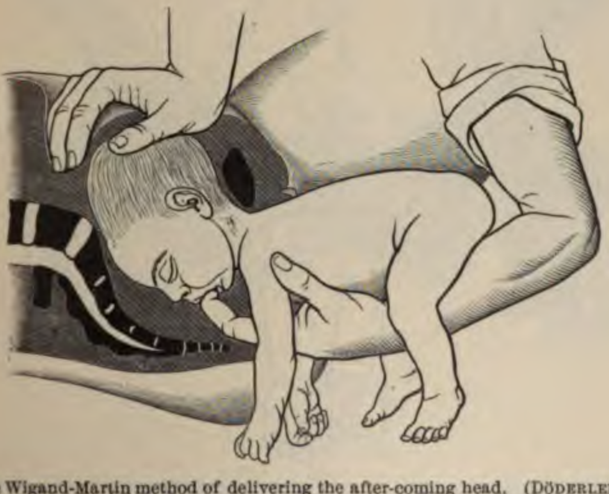
cciput is to the back they will lie under the back of the child; when to the front they will lie under the abdomen.

Fig. 311.



The Smellie-Veit method of extracting the after-coming head. (Döderlein.)

Fig. 312.



The Wigand-Martin method of delivering the after-coming head. (Döderlein.)

Delivery after Embryulcia. In cases in which the head ot be delivered by any of the above methods, reduction of the head erforation is necessary. This may be done through the skull or ugh the base of the mouth.

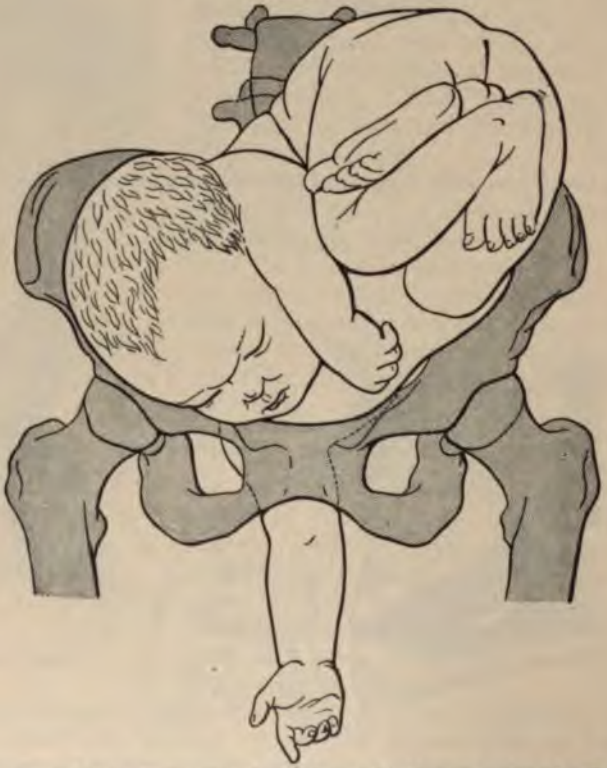
MALROTATION OF THE HEAD. Sometimes in the pelvis the head stays with its long diameter in the transverse, or with the occiput in the hollow of the sacrum. In these cases it is best to hold the head and trunk firmly by the Smellie grasp and to rotate them so that the occiput comes to the front, delivery being continued as already described.

TRANSVERSE PRESENTATIONS.

FREQUENCY. Various statistics are given, varying from 1 in 150 to 1 in 300. It might be generally stated that less than ½ per cent. of all cases of labor present transverse presentations.

CAUSES. The causes are those of malpresentation in general—*e. g.*, excess of liquor amnii; prematurity of labor; death of the fœtus, by which its tone is lost; changes in the shape of the fœtus by disease—*e. g.*, hydrocephalus; malformations and monstrosities; multiple pregnancy; irregular contractions of the uterus; tumors of the uterus; tumors of parts near the uterus; uterine malformations; placenta prævia.

FIG. 313.



Transverse presentation. Dorso-posterior, head on right side, arm prolapsed. (FARABEUF.)

VARIETIES. Any part of the body of the fœtus may present; usually it is the shoulder, sometimes the hand or elbow, rarely the trunk. The long axis of the trunk is very rarely transverse; it is usually obliquely placed in relation to the long axis of the uterus.

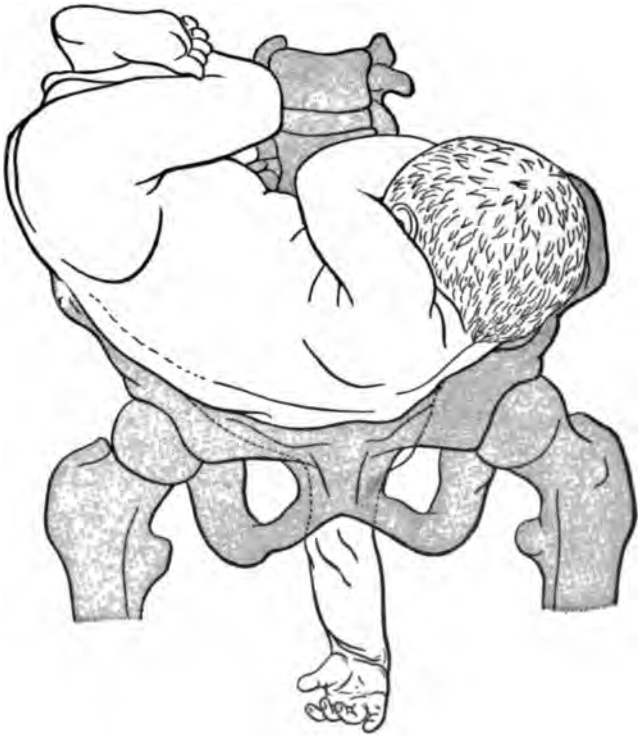
POSITIONS. Attention need be paid only to the shoulder cases. The nomenclature employed differs in different countries. By some the acromion process is used as the denominator, by others the spine of the scapula. Certain writers prefer to make use of no denominator whatever. It is, indeed, quite sufficient to classify the positions as follows:

- Dorso-anterior:
  - Head on the right side.
  - Head on the left.
- Dorso-posterior:
  - Head on the right side.
  - Head on the left.

The dorso-anterior position, the head being on the left side of the mother, is the most frequent, and to it we will particularly allude in describing the mechanism of labor.

DIAGNOSIS. External abdominal examination reveals the unusual shape of the abdomen. The normal regular prominence of vertex and breech cases is absent. The regular pyriform shape of the uterus is wanting. It is felt to be moulded somewhat obliquely or transversely by the fœtus. The head lies usually in an iliac fossa. The back is made out if it be to the front, or the irregularities of the limbs if they are

FIG. 314.



Transverse presentation. Dorso-anterior, head on left side, arm prolapsed. (FARABEUF.)

anterior. The fœtal heart-sounds are heard below the umbilicus in a dorso-anterior position, being conducted along the back of the fœtus.

If labor has been delayed and the uterus has been active, there may be an abnormal thinning and stretching of the lower uterine segment, so that the fœtal parts may be felt very distinctly just above the symphysis; and, higher up, the thickness of the retraction ring, where the lower uterine segment of the body of the uterus joins the upper, may be made out.

On vaginal examination early in labor the presenting part is usually very high, the vaginal fornix being somewhat flattened. The lower uterine segment is imperfectly filled, and the cervix may be felt hanging loosely. As labor proceeds the bag of membranes tends to protrude into the vagina in a sausage form and to be ineffective as a dilator. It tends to rupture early, and the cord also tends to prolapse. When the fingers can be passed into the cervix the shoulder may be recognized by the three bony ridges, clavicle, humerus, and spine of scapula running toward a central spot. A finger may be passed into the axilla, and the ribs felt, thus distinguishing it from the groin.

Sometimes the elbows or hand may be distinguished. The diagnosis of these from knee and foot is given on page 454. To know which hand is prolapsed, it is best to shake hands with it, and thus to identify it.

Prognosis. In cases left to nature the risk both to mother and child is very great. The risk may be increased by the causes of the malpresentation. As artificial delivery is now the rule in these cases, the prognosis is modified by and dependent upon the nature of the operative interference. The longer labor is allowed to proceed before treatment is carried out, the greater is the danger to the mother.

The chief risks to the mother are exhaustion, rupture of the uterus, the results of operative interference, and after-inflammation. We have already referred to the great thinning and stretching of the lower uterine segment in a delayed transverse case; it is this part which is most apt to be ruptured.

Methods of Spontaneous Delivery. 1. *Spontaneous Version.* This is the change by which nature alters the presentation from the transverse to that of the head or breech, the delivery then taking place according to the new presentation. This is most apt to occur in multiparæ whose uterine walls are lax. It is more apt to occur in the case of a living than of a dead child.

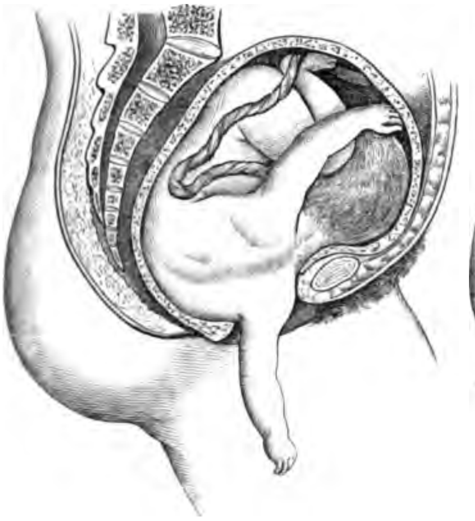
This version may occur before the membranes have ruptured as well as afterward. In the former case the pains may be weak. In the case of version after the membranes have ruptured, the amniotic fluid having partly or wholly escaped, the presenting part must be movable and not jammed in the cervix or brim, and the uterine pains must be strong. As the uterus contracts on the fœtus it is driven against the cervix, which is only partly dilated, firm, and resistant. The presenting part is gradually displaced to one side, and this is continued until version is partly or wholly completed.

(It is interesting to note that occasionally, if left to nature, a complete rotation may be carried out, one transverse presentation being substituted for another. This only takes place when there is a small child and plenty of liquor amnii.)

2. *Spontaneous Evolution.* (*a*) Most common variety (Douglas). The delivery in this variety is by a special mechanism. Certain conditions are favorable to its successful progress. The pains must be strong, the pelvis roomy, and the fœtus small. Softness and compressibility of the fœtus are particularly likely to favor this mechanism. There is no doubt, however, that it may take place where the fœtus and pelvis are of normal size. Very strong pains are the chief essential.

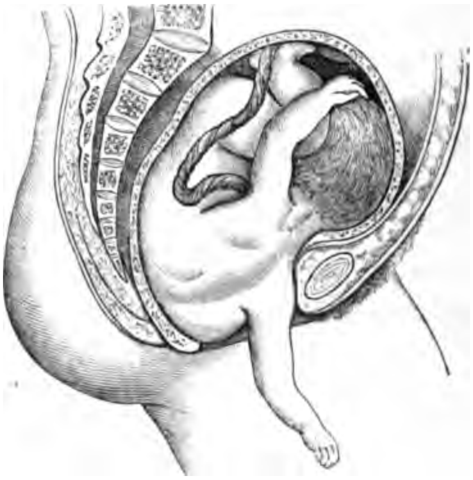
First of all, the fœtus is packed into the brim, the presenting shoulder being forced downward to the pelvic floor, and rotated forward until it rests under the pubic arch, where it sticks, the corresponding arm usually hanging outside the vulva. At this period the fœtus is so lateriflexed that the head is above the brim, lying alongside the breech, the latter being posterior. The chest is now driven down past the shoulder, then the abdomen and lower limbs, the presenting shoulder all this time pivoting on the pubic arch. Finally the head enters the pelvis and rotates, so that the occiput passes under the symphysis as its delivery is completed.

FIG. 315.



Spontaneous evolution. First stage.

FIG. 316.



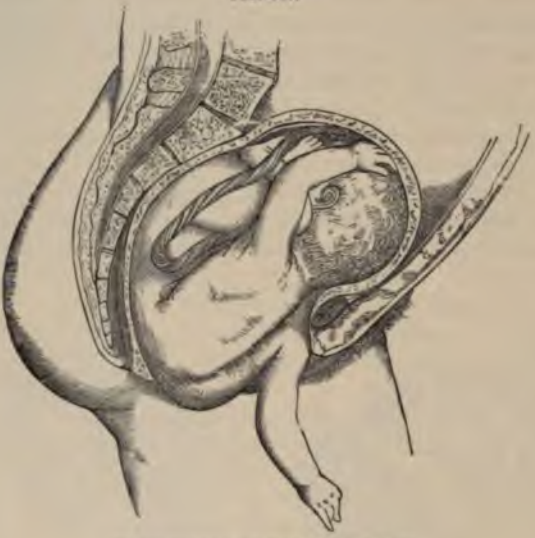
Spontaneous evolution. Second stage.

(*b*) Rare variety (Röderer, Kleinwächter). In this form the body is delivered with doubled body (*evolutio conduplicato corpore*). The conditions which favor it are compressibility of the fœtus, small size of the fœtus, and a large pelvis. When the fœtus is dead, therefore, it can the more easily occur.

The presenting shoulder is pushed down into the pelvis, the head also being crowded into it along with the body. The arm belonging to the lowermost shoulder protrudes from the vulva; the other one lies between the breech and the head. The mass thus doubled is driven down, the presenting shoulder being delivered first, then head and chest together, and, finally, the breech and legs.

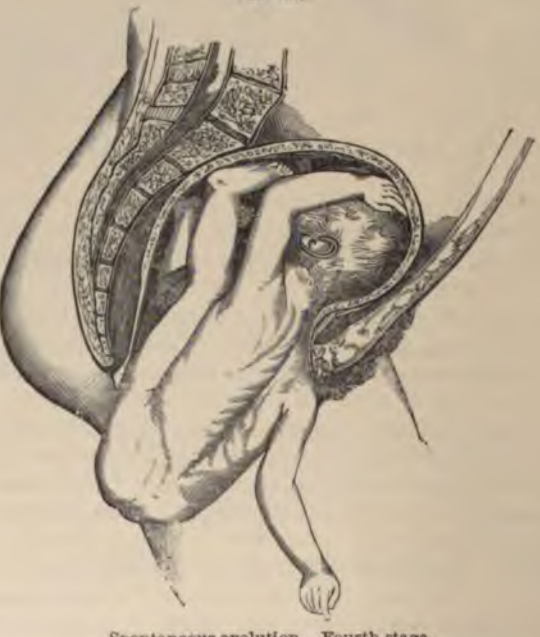
MANAGEMENT. Transverse cases should not be left to nature. Artificial delivery must be carried out. If the condition be diagnosed before the membranes are ruptured or the presenting part jammed at the brim, *version* should be performed. The bipolar or Braxton Hicks's method

FIG. 317.



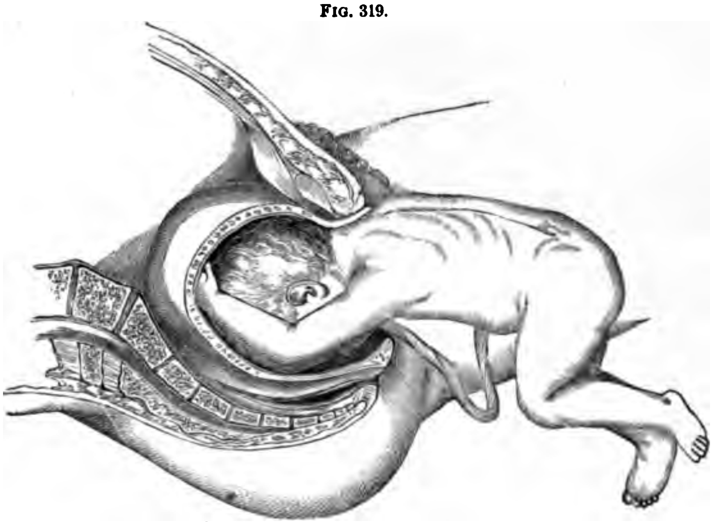
Spontaneous evolution. Third stage.

FIG. 318.



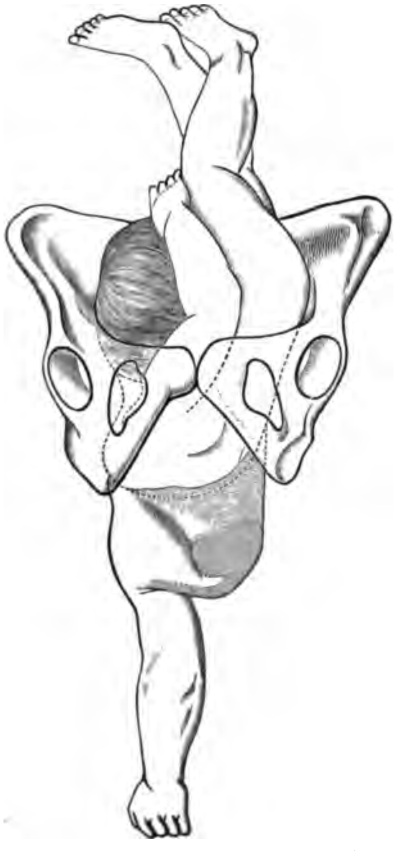
Spontaneous evolution. Fourth stage.

FIG. 319.



Spontaneous evolution. Fifth stage.

FIG. 320.



Birth of child doubled. Evolutio conduplicato corpore. (KLEINWÄCHTER.)

should be adopted when the cervix is only partly dilated, the vertex or breech being made to present. If it is a shoulder case, it is best to try to bring about a vertex presentation unless the pelvis be flat, in which case a breech presentation is best.

If the abdomen presents, a pelvic presentation should be induced.

At first external manipulations through the abdominal wall should be tried, in order to turn the fœtus, anæsthesia being employed. If this method fail, other measures must be carried out.

When the cervix is well dilated the bipolar method may also be adopted if the liquor amnii is still in utero. When it has escaped, internal or podalic version must alone be tried; before the rupture of the membranes this method may also be employed, the membranes being ruptured artificially.

How long after the escape of the liquor amnii it is feasible to perform podalic version, cannot be definitely stated. Different authorities give different limits. The student should bear in mind that the nearer to the time of rupture, the easier and safer is the procedure. It should never be carried out when the uterus is firmly contracted on the fœtus, or when the latter is jammed into the inlet. There is always risk of rupturing the uterus. The patient should always be deeply anæsthetized in performing internal version.

In transverse cases where turning is impracticable, the child must be broken up by one or other of the following methods:

Decapitation may be carried out, when the neck is accessible, by a blunt, a serrated, or a sharp hook. The body may then be extracted, and afterward the head.

Evisceration, or removal of the contents of the abdomen and thorax, is recommended by some. This is not, however, a satisfactory procedure.

Spondylotomy, dividing the spinal column with scissors, or spondylolysis, breaking it up with a basilyst, is a better means of reducing the size of the child before extraction.

PROLAPSE OF THE LIMBS.

(*a*) **In Head Presentations.** 1. One or both arms may be prolapsed in front, behind, or at the sides of the head. When one arm prolapses it usually lies close to the temporal region. The worst form is that in which the arm is across the back of the neck. Sometimes the arms are folded under the chin, bringing about a brow or face presentation (*q. v.*).

TREATMENT. If the condition be diagnosed before rupture of the membranes, nothing should be done until the cervix is completely dilated. Then the hand may be pushed up to allow the head alone to engage in the brim. If this fail, forceps may be applied to the head if there be no risk of catching the arm, or version may be carried out. In extracting with forceps the arm may slip up. When the case is made out only after the arm is well engaged in the brim, the head should be delivered with forceps.

2. A foot may present with the head. The line of treatment is the same. Embryulcia may sometimes be necessary.

(*b*) **In Breech Presentations.** Sometimes the hand presents. Nothing need be done. The hand may or may not slip up.

(*c*) **In Transverse Presentations.** If a foot presents, the condition is not unfavorable, for as version is the usual treatment, it can be carried out more easily. If an arm presents, it may interfere with the entrance of the physician's hand prior to the performance of podalic version. Sometimes it may be pushed up out of the way while the operator's hand is being introduced. Generally it is advisable to fasten a piece of tape around the prolapsed wrist, so that it may be drawn out of the way and prevented from ascending during the delivery of the thorax.

Anomalies of Fœtal Development.

Shortness of the Cord. This may be "absolute" when the cord has only a length of a few inches, or "accidental" when the length is reduced by coiling around the neck, body, or limbs. The latter is more frequently a cause of delay in labor. Sometimes the placenta may be detached in this condition; sometimes the cord ruptures, or is so compressed as to lead to the death of the child. Most umbilical cords break under a weight of 8¼ pounds; some resist as much as 15 pounds; others will not sustain 6 pounds.

It is difficult to state what actually constitutes a short cord. It varies with the amount of stretching it will bear, with the place of attachment to the placenta, with the site of the placenta, and with the tightness of the coils.

THE DIAGNOSIS of this condition is not easy. Sometimes there is marked pain at the placental site during contractions, marked recession of the head between pains, delayed labor, and occasionally irregular fœtal heart-action.

When the cord encircles the fœtus and the latter is driven down, it rotates partly with the pains to undo the coiling, and so to relieve tension.

THE TREATMENT consists in freeing the coils, where it is possible, or in dividing the cord and delivering by forceps. If the cord cannot be ligated, two artery forceps may be attached to it, and it may be divided between them. Where these procedures cannot be carried out forceps should be applied if the head presents, and labor should be hastened if it be a breech case.

Unduly Ossified Skull. The skull bones may be prematurely or abnormally ossified, the sutures and fontanelles being partly or wholly closed. The head fails to undergo moulding in labor and delay results; it may be arrested in the brim or pelvic cavity.

The application of forceps, symphyseotomy, or embryulcia may be necessary to delivery.

Large Size of the Fœtus. In the case of a large child—*e. g.*, eleven pounds or more, there may be delayed labor. There are records of children delivered weighing more than twenty pounds. The causes are not definitely known. It is thought that multiparity, large size or advanced age of one or both parents, and unusual extension of the period of pregnancy are related to its occurrence.

The mechanism of labor by which the head attempts to pass through the pelvis is like that which takes place in a justo-minor pelvis, viz., by extreme flexion. The head becomes greatly moulded. Cephalhæmatoma may be produced.

TREATMENT. In cases which are not very marked, extraction may be carried out with forceps. In very marked cases, however, this is useless, and may lead to bad lacerations. Pinard's rule is a good one, viz., never to overcome bony resistance by forceps-traction. Embryulcia or symphyseotomy is then necessary.

DEATH OF THE FŒTUS.

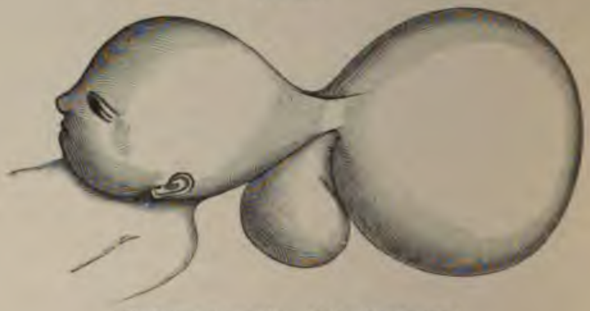
When a fœtus dies in utero decomposition changes may cause distention of its tissues with gas, and this condition, known as *emphysema*, may delay labor. In such a case it may be necessary to puncture the abdomen, or any part distended, to allow the gas to escape. Rigor mortis may sometimes take place in the body and interfere with its quick passage.

It is to be remembered that absorption from a decomposing fœtus may hurt the mother.

ENLARGEMENT OF HEAD OR BODY BY DISEASE.

Hydrocephalus. This condition causes delay and trouble in labor, varying according to the nature of the hydrocephalus. The head enlarges by an accumulation of serum in the ventricles of the brain, especially in the lateral ones. Sometimes a collection in the membranes covering the brain, especially the subarachnoid space, may cause enlargement, and a projection may take place through the skull, known as *hydromeningocele.*

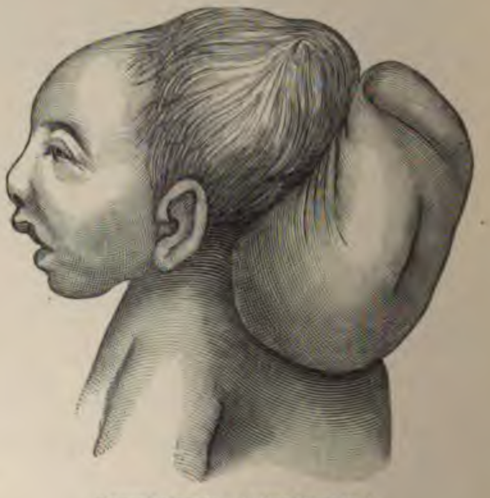
FIG. 321.



Hydromeningocele. (After HERRGOTT.)

In the former of these conditions, where the disease is not much developed, the bones, fontanelles, and sutures may appear normal, with the exception that the bones are thinned, the brain being well formed, large. In more marked cases the ventricles are enlarged, the br convolutions somewhat obliterated, and the bones of the cranium se rated from one another and thinned. The forehead is increased in relative to the face, the frontal bones bulge, and the superciliary rid

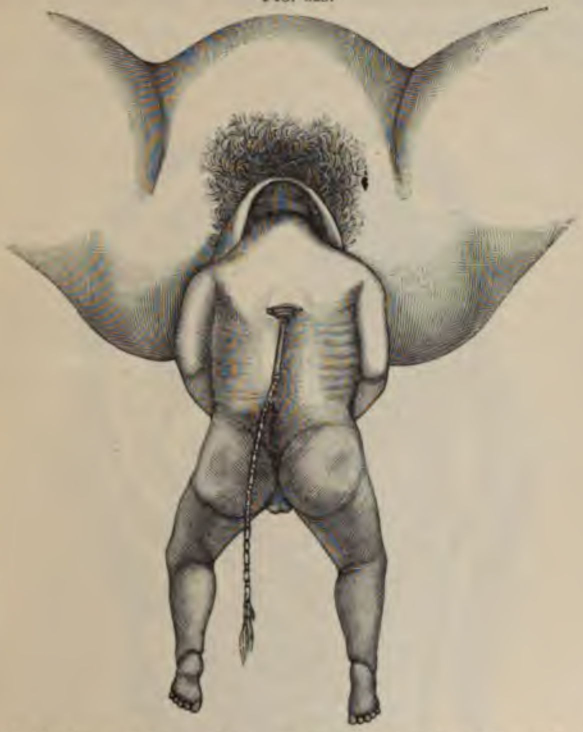
FIG. 322.



Encephalocele. (After VROLIK.)

ominent. In the most extreme degree the head is very large,
mainly membranous, the brain being represented only by a thin
d by traces of cerebral tissue at the base. Sometimes hydroen-
ocele is formed during the course of enlargement, owing to the
on outward, between a deficiency of bone, of the skull contents.
a bifida, or some other malformation, may also occur. Sometimes
ge sac ruptures, the membranes collapsing and becoming attached
brain structures at the base of the skull (anencephalus or hemi-
us). Hydramnios may be present. Breech presentation is frequent.

FIG. 323.



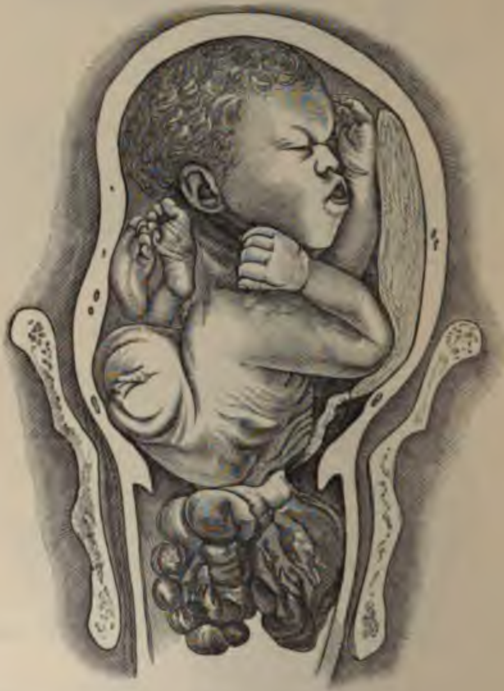
cture of spinal canal in a case of hydrocephalus obstructing labor. (After HERRGOTT.)

GNOSIS. On abdominal palpation, where the head is distinctly
ed, it may be easily felt. When the breech presents the head is
at the fundus uteri. The abdomen may be abnormally distended.
ginam, during labor, the wide fontanelles and sutures may be felt.
archment-like bones may be distinguished, or a membranous con-
of the vertex may be felt—a fluctuating sac becoming tense
the pains. Or islands of bone may be distinguished in the mem-
Sometimes a hydrocephalus may be present, but the bones may
and the sutures more or less ossified; in this case it may be more
lt to establish a clear diagnosis unless the head is considerably
ed.

GNOSIS. This varies according to the degree and extent of the disease and the nature of the treatment which is employed. The longer the delay the greater the risk. Death of the mother may occur from exhaustion or from rupture of the uterus. Rupture generally occurs in the lower uterine segment, which becomes greatly stretched and thinned; but it may take place higher up. Vesico-vaginal fistula may result from long-continued pressure. The child very often dies.

RELATION TO LABOR. Sometimes there may be little delay even when the head is large. This is due to softness and compressibility of the skull, especially when somewhat macerated or when it is mainly membranous, and to rupture of the membranous cranial sac. The latter occurrence is most apt to take place when the breech presents. Delay may occur at the brim or in the cavity.

FIG. 324.



Exomphalos. (After A. R. SIMPSON.)

TREATMENT. Little value need be attached to the life of the child. If it does not die in utero, it usually dies soon after birth.

When the head presents it should be perforated and drained with a trocar. When the head collapses, delivery may be effected either by version or by embryulcia if the former method be inadvisable.

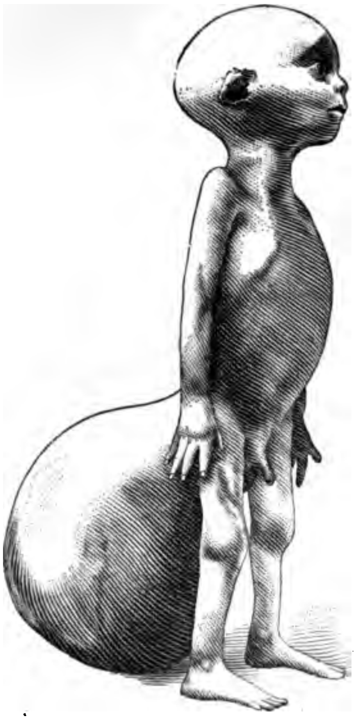
If the fœtus presents by the breech, either the head may be perforated behind the ear, as it lies at the brim, or Tarnier's method may be adopted, viz., to open the spinal canal and draw off the fluid by an elastic catheter passed through the spinal canal into the head.

In the cases where the skull is enlarged, the bones still firm, and the sutures possibly ossified, it is usually necessary to perform embryulcia.

Hydrothorax may cause trouble; it is generally associated with ascites, anasarca, or other conditions. It may obstruct labor, usually when the head has passed the brim. It may be necessary to puncture the thorax and extract with a cranioclast, reducing the size of the head, if necessary. Pericardial effusion may sometimes be very great.

Ascites is sometimes met with, and is due to various conditions—*e. g.*, abdominal tumors, syphilis. It may be a cause of obstruction, and in some cases a very marked one. As soon as the condition is diagnosed the size of the swelling should be reduced. This may be carried out by direct puncture of the abdomen. But it may be necessary to reach this part through the thorax. If a large tumor exists, it may be necessary to break it up or remove it.

FIG. 325.



Sacral tumor. (KELLER: Mütter Museum, College of Physicians.)

Distention of the Ureters and Hydronephrosis are rare.

Dilatation of the Bladder. This condition is occasionally found. The urethra may or may not be imperforate. The fœtus is rarely born alive, or, if living, soon afterward dies. It may sometimes be associated with ascites.

Dilatation of the Uterus, the cervix being closed, is very rarely found.

General Œdema of the body is occasionally met with.

Abdominal Intrafœtation has been reported. In this condition the abdomen contains another fœtus, or part of one, which causes enlargement.

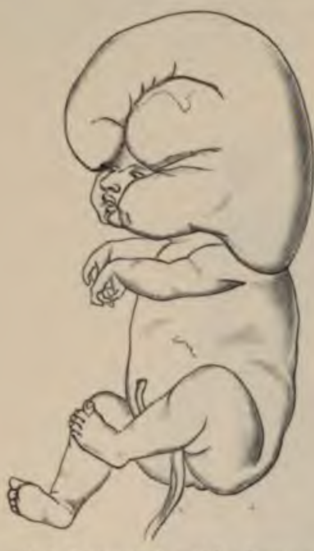
Umbilical Hernia, or hernia through some other part, may lead to obstruction in labor.

Exomphalos may cause delay.

Tumors of the liver, kidney, spleen, pancreas, and other viscera, sometimes occur.

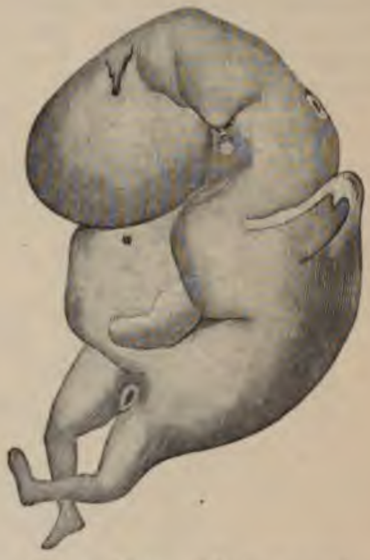
Hydrorrhacis. This usually occurs with spina bifida. It is a collection of fluid in a sac composed of the spinal membranes and skin, and is usually in the coccygeal or sciatic region. The swelling varies; it may be very large.

FIG. 326.



Congenital elephantiasis. (After STEINWIRKER.)

FIG. 327.



Œdema of fœtus. (After BETSCHLER.)

Tumors of various kinds, simple or malignant, may obstruct delivery—*e. g.*, cystic, vascular, fatty, cartilaginous, bony, sarcomatous, carcinomatous, teratomatous. Most frequently they are found in the region of the sacrum and coccyx—*e. g.*, cystic hygroma. The neck is also an occasional seat of a growth. They are, however, found in every region of the body.

TREATMENT. The general treatment for these conditions is as follows: When the swelling is only slight, delivery may be effected by forceps or version; if the breech present, by traction and pressure from above.

If too large for delivery, puncture of the swelling or reduction by embryulcia and evisceration are necessary. Thus, if, in a head presentation, the abdominal swelling cannot be reached without opening the thorax, the latter procedure should be carried out. It may even be necessary to reduce the head in size or to amputate it in order to get room. Sometimes the swelling bursts of itself.

The following very rare conditions sometimes cause obstruction, viz., anchylosis of joints, adhesions of limbs to the body, anchylosis of fœtus to placenta or uterus.

PLURAL BIRTHS.

Twins. RELATION TO LABOR. In a large percentage of cases twin labors are easy and uncomplicated. After the birth of the first child the second follows, there being an interval between, usually of less than an hour in extent, though it may be longer. Several cases have been reported in which the second child was born a day or two after the birth of the first. Kalnikoff has described one in which there was an interval of three days, both twins surviving; both placentæ were removed at the second delivery. The placentæ are generally delivered after the second child. Sometimes the first child may be followed by its own placenta. Sometimes the second placenta precedes the second child. Where the placenta is a large single one, it follows the birth of both fœtuses, though sometimes a portion may be torn off and expelled with the first child.

The following percentages are given by Spiegelberg to show the relative frequency of the presentations met with:

Both heads presenting, 49 per cent.
Head and breech, 31.70 per cent.
Both breech presentations, 8.60 per cent.
Head and transverse, 6.18.
Breech and transverse, 4.14 per cent.
Both transverse, 0.35 per cent.

The pains may be weak in twin cases, owing to the overstretching of the uterus, and there may be trouble in the third stage from this reason also. Hydramnios may be present. In some cases this may be found only in one amniotic cavity, oligohydramnios being the condition in the other.

PROGNOSIS. The mortality of the children is considerably greater than in single births. This is due to various causes. The labors are often premature and the fœtuses, consequently, in an undeveloped state, one being usually weaker and smaller than the other. Malpresentations and malpositions are frequent, necessitating artificial delivery. The maternal risk is also considerable. This is due to the delay which is often present as a result of weak pains; albuminuria is often found; eclampsia is more frequent than in single births; there may be trouble in the third stage from the large placenta, and from inertia uteri; post-partum hemorrhage may occur; there is a greater risk of septic absorption in the puerperium. If there is complete obstruction to the passage of the twins, the patient may die of exhaustion or of rupture of the uterus. Then there are risks attendant upon operative interference.

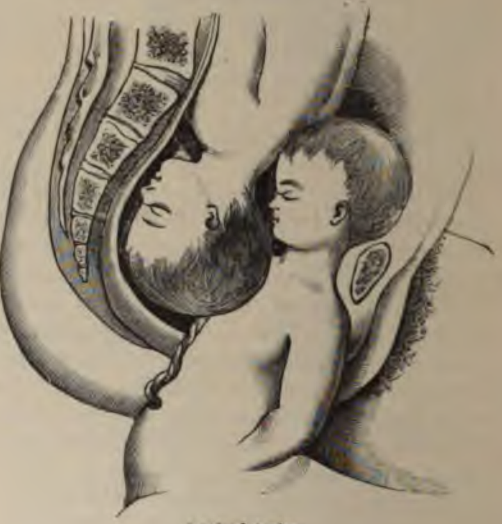
MANAGEMENT OF LABOR. After the birth of the first child the cord must be tied in two places and divided, lest there be communication between the placental circulations and the second child should bleed to death. The uterus should then be gently kneaded through the abdominal wall to favor its retraction. There is a difference of opinion as to how long a time should elapse between the birth of the first and that of the second child. Our opinion is that it should not be prolonged, for, though the mother may gain strength, retraction and contraction of the cervix may occur. If the second child is transverse it should be turned. This may often be done by external manipulations. While the second child is being born a hand should be kept on the abdomen following the uterus. After this child is born the hand should hold the fundus uteri until the placenta is delivered. If there should be partial s the placenta and hemorrhage, the uterus should be emptied If there is inertia of the uterus, special care must be taken, the methods described on page 415.

When the second child is discovered only after the birth the mother should not be informed, lest the shock should inh action.

If, after the birth of the first child, an hour elapses without of the second, the second bag of membranes, if there be on ruptured, and the child delivered by version or forceps.

In some cases it may be necessary to deliver the second earlier—*e.g.*, if both placentæ should be born before it, or if t be much hemorrhage following the birth of the first child.

FIG. 328.



Locked twins.

Complex Cases. 1. Sometimes labor may be delayed by t in the dilating cervix of two bags of membranes. When complete the bag of the leading child should be ruptured.

2. Where both presenting parts tend to enter the brim t should be pushed up to allow the other to engage. Where one and the breech of the other are so placed, the head should to engage.

3. **Interlocking Twins.** In some cases the twins may beco This may happen in two ways:

(*a*) Where both heads present, the second may enter the the first and jam against the neck or thorax. The heads mus be small to permit this complication.

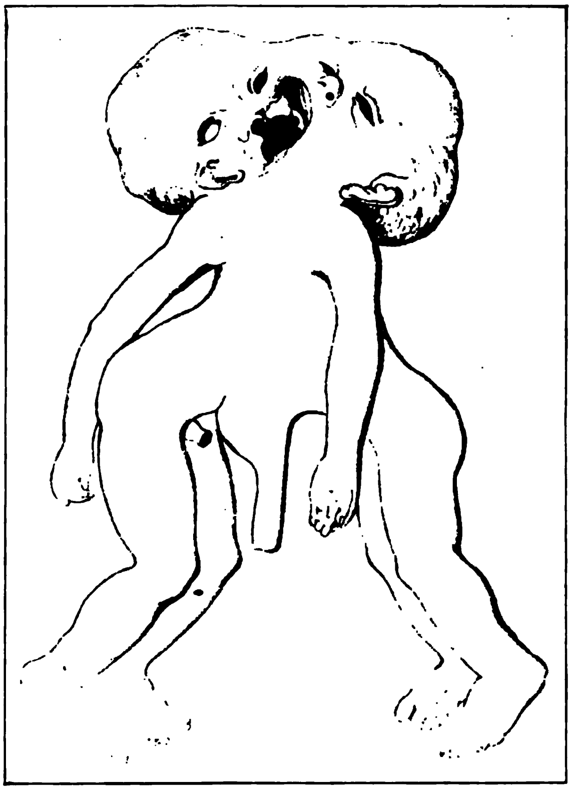
TREATMENT. The most advanced head should be delivere ceps, and then the other should be delivered.

Sometimes embryulcia of one is necessary. This should b on the first child, because the second is more likely to be alive, there being less risk of compression of its cord.

(*b*) In some cases where one child presents by the breech and the other by the head, the former may be delivered as far as the neck, but no farther, because the head of the second child has locked with that of the first; this may take place by overlapping of the chins, or of the occipital regions, or the face of one may be pressed against the back of the neck of the other. This locking occurs in the pelvis.

TREATMENT. Sometimes the head of the second child may be pushed up. If this is impossible, and nature cannot soon bring about delivery, the head of the second child may be delivered by forceps. If this is impossible, or if there is great difficulty in applying the blades, embryulcia should be performed on the head of the child which is dead. In almost every case this is the breech-first child. After the extraction of the mutilated child the other may be delivered.

FIG. 329.



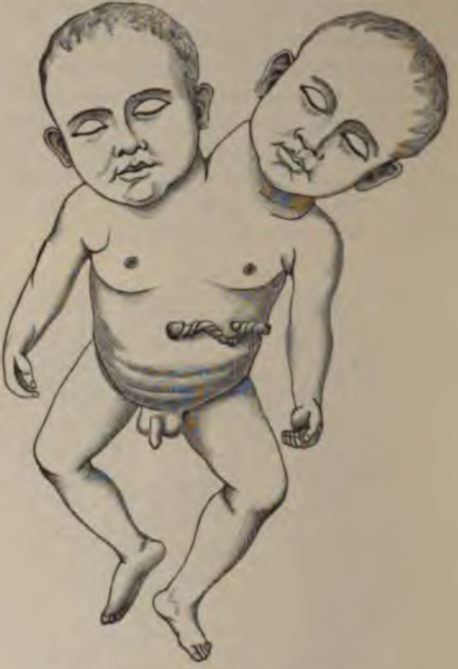
Prosopothoracopagus.

4. **Interlacing and Knotting of the Umbilical Cord.** This may occur where there is only one amniotic sac. The cords may be twisted around one another in various ways, or even knotted. If this happens early in pregnancy there is great probability that death of one or both twins will occur and premature labor be induced. It may, however, be found at full

time. As labor proceeds one cord may drag on the other and imperil circulation.

TREATMENT. If after delivery of the first child the condition is diagnosed, the second child should be delivered at once by version or turning.

FIG. 330.



Derodyme or derodidyme. (After AHLFELD.)

Triplets. The greater the number of fœtuses the greater the tendency to prematurity of delivery. Consequently, the labors may sometimes be comparatively easy. Sometimes, however, they are considerably prolonged. The first stage is usually longer than normal.

Albuminuria is more frequent; also inertia uteri and hemorrhage during or after labor. In 458 triplet cases collected by Charbonnier there were 254 head presentations, 117 breech, and 57 transverse. According to this author there is a very small percentage of cases in which malpresentation and malpositions have caused serious trouble. The third stage must be very carefully attended to. Generally the three fœtuses precede the placentæ. Sometimes, however, each is followed by its own. Sometimes there are two fœtuses, then one or two placentæ, followed by the third fœtus and its placenta. Sometimes one fœtus and its placenta are first, then the other two and their placentæ.

MONSTROSITIES.

Anencephalus or Hemicephalus. In this form the neck is short and the shoulders may be very broad.

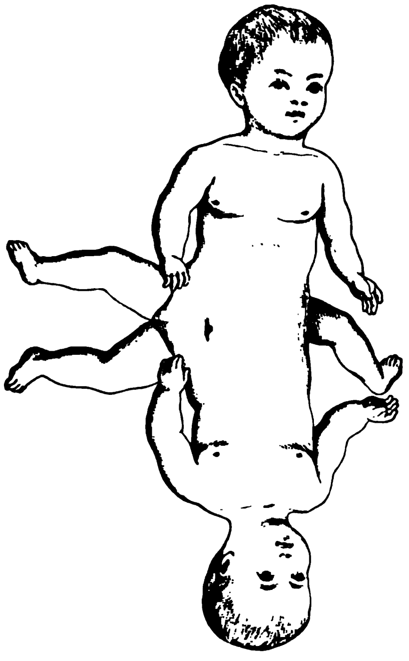
Delay in labor is caused by the bad action of the deformed head as a **dilator**, by the breadth of the shoulders, or by the entrance into the brim of the small head along with other parts of the fœtus. Turning should be employed if the case be diagnosed early enough.

Acardiacus is another rare monstrosity which may interfere with labor.

Double Monsters. These may be considered in three main groups:

1. Those in which there is double formation in the upper part of the body—*e. g.*, a two-headed monster.
2. Those in which there is double formation of the lower part.
3. Those in which there are two heads and two bodies:
   (*a*) Those in which the backs are united.
   (*b*) Those in which the bellies are united.

FIG. 331.



Ischiopage.

DIAGNOSIS. This may be very difficult during labor. It can be best arrived at when the hand is passed into the uterus. Double monsters are apt to be mistaken for twins.

RELATION TO LABOR. In many cases these monsters are delivered naturally, probably because the fœtus is usually small.

Lroff has recommended the following treatment: When both heads present, and are movable, one should be pushed up, in order to allow the other to engage. Turning may sometimes be tried in order to deliver the legs first. Forceps may be used to aid the advancing head. Sometimes embryotomy is necessary.

CHAPTER XXI.

ANOMALIES ARISING FROM ACCIDENTS OR DISEASE.

Prolapsus Funis.

IN this accident a loop of the umbilical cord slips down alongside the presenting part or in advance of it. As the labor progresses the displaced portion of the cord is exposed to strangulation by pressure between the presenting part and the walls of the birth-canal. Unrelieved, the complication, as a rule, results in the death of the fœtus within a few moments by interruption of the fœto-placental circulation. In exceptional instances the cord may escape injurious pressure and the child be born alive. This is possible when the pelvis is relatively roomy and the expulsion of the fœtus is accomplished in one or two pains. Prolapse of the cord may take place before labor begins, but in the majority of cases it does not occur until the cervix is well dilated. Ordinarily the two halves of the prolapsed cord lie in apposition, but occasionally the presenting portion of the child may intervene. Thus in vertex presentation the loop may extend upon opposite sides of the head, and in shoulder or footling presentation may include an arm or a leg. The prolapse occurs most frequently at one side of the promontory, rarely along the lateral wall of the pelvis, and still more rarely near the median line in front.

When the prolapse is within the bag of waters it is sometimes spoken of as a presentation of the funis.

Frequency. The frequency of prolapsus funis as generally estimated is about 1 in 250 labors. According to Winckel, it happens once in from 65 to 500 cases. In a collective investigation by Churchill, prolapse of the cord was reported 852 times in 91,000 births, an average of 1 in 107 cases. The complication is met most frequently when an extremity presents, next in order of frequency in breech, and last in vertex presentations.

Etiology. The essential cause of prolapse of the cord is failure of the presenting part of the fœtus to fill completely and continuously the lower uterine segment. Conditions, then, which may give rise to this lack of close approximation are predisposing causes of prolapsus funis. They are: narrow pelvis, which may act not only by hindering the adaptation of the head to the passages, but by favoring the occurrence of malpresentation; uterine myomata; diminished size and consequent mobility of the fœtus, favoring malpresentation and malposition; abnormal presentations, especially breech, shoulder, footling, and face presentations; excess of liquor amnii, causing preternatural mobility of the fœtus; low implantation of the placenta; marginal insertion or excessive length of cord; twin pregnancy, multiparity, owing to relaxation of the abdominal walls and to uterine obliquity, especially to pendulous abdomen.

An important exciting cause is premature rupture of the membranes and the sudden escape of a large amount of amniotic fluid, particularly if the woman is in a standing or half-sitting posture when the rupture occurs; the escaping fluid may sweep out a loop of the cord in front of the presenting part of the child. Violent movements on the part of the mother favoring recession of the fœtus from the lower uterine segment and the gravitation of the cord may be included among the possible factors in bringing about the displacement. Maladroit attempts at version are sometimes responsible for the prolapse.

Diagnosis. The examination should be made between the pains. The condition can scarcely be recognized before the os has dilated if the membranes are still intact. It may rarely be possible, if the lower uterine segment is thin, to detect, with the examining finger at the utero-vaginal junction, the pulsation of the cord. It is distinguished from maternal pulse by the count. If the os is sufficiently dilated to admit the finger, the cord may be felt when it lies well down in the membranes. Yet it may escape detection, owing to the facility with which it recedes from the examining finger. When the fœtus is dead, pulsation is, of course, absent. The absence of pulsation, however, can be taken as evidence of fœtal death only when persistent for ten or fifteen minutes. The funic pulse may be interrupted temporarily by compression of the cord between the pelvic brim and the presenting part. Fingers and toes are distinguished from the cord by their anatomical characters. Fœtal parts, too, will sometimes be drawn up when touched. The prolapsed cord should not be mistaken for intestine. The latter is recognized by the mesentery and by the absence of pulsation. It is larger than the cord and not so firm in consistence. After the membranes have ruptured and the cord protrudes into the vagina, or through the vulva, the diagnosis presents no difficulty. The presence or absence of pulsation should always be noted, to determine whether the child is living or not, since this question will obviously have an important bearing on the treatment. Should the displaced loop be caught between the presenting part and the sides of the pelvis, but fall no farther, the condition may escape detection and the child be asphyxiated before the cause is discovered. Winckel says that whetn he fœtal heart-sounds grow continually feebler and no cause is apparent, prolapse of the funis should be suspected, and the physician should act accordingly.

Prognosis. In general this complication of labor has, of itself alone, little influence upon the mother. The treatment necessitated in the interest of the child frequently subjects the woman to the risks of shock, hemorrhage, and sepsis usually attendant upon forced delivery.

For the child the prognosis is exceedingly grave. More than half the children die of asphyxia. Churchill places the infant mortality at 53 per cent., Scanzoni at 58 per cent. Depaul, in 143 cases, had 96 deaths. The prognosis, however, must necessarily vary with the conditions of the case, such as the position and presentation of the fœtus, the degree of displacement, the part of the pelvis at which it occurs, the size of the cord, and the duration of the prolapse. Prolapse of the cord in vertex and even in breech is more surely fatal to the fœtus than in other presentations, since the presenting part more completely fills the pelvis and the cord is more certainly strangulated. The risk to the fœtus is comparatively small while the membranes are intact. The possibility of escaping injurious pressure is obviously greater when the cord lies in that part of the pelvis in which there is most room. The size of the cord has some influence, since the thicker the cord the greater the amount of Wharton's jelly and the consequent protection of the vessels. With primiparæ, in whom the passages are more unyielding and the labor more prolonged, the fœtal mortality is greater than with women who have borne children.

Treatment. When the child is surely dead or non-viable, the reposition of the cord is obviously not called for.

Before Rupture of Membranes. When the child is living and the membranes are unruptured, the latter should, if possible, be preserved. It should be a general rule before rupturing the membrane in any case first to examine for possible prolapse of the cord. For reduction of the displacement while the bag of waters is still intact postural measures should be tried. Harm can seldom come to the fœtus from the prolapse so long as the waters have not escaped. The woman is required to lie on the side opposite that on which the cord has come down. Gravity thus favors the return of the prolapsed loop. The reposition may be assisted, if need be, by gently pushing up the cord between the pains, with care to avoid breaking the membranes.

Should this fail the woman may be placed in the knee-chest position. In this posture the inverted axis of the uterus is nearly vertical, and gravity acts at the greatest advantage. The Trendelenburg posture may serve as a convenient substitute for the latter position. While not so effectual as the knee-chest, it is more so than the lateral posture ; the inclination should be about 45 degrees.

The fœtal heart is to be listened for at short intervals. The cord once reposited, to prevent recurrence of the prolapse the presenting part should be crowded into the excavation and firmly held there till engaged.

A fairly good Trendelenburg posture may be had by raising the foot of the bed or cot, slipping down in the bed being prevented by the help of assistants ; or a chair placed prone upon the bed may be utilized, the back being covered with a folded comfortable.

After Rupture of the Membranes. If the fœtal pulse can be felt, the cord should be replaced, if possible. If pulsation has ceased and the fœtal heart is still beating, the presenting pole of the fœtus should be pushed up and the cord reposited after pulsation returns. Two methods are available—the manual and the instrumental. Either is to be undertaken with the aid of posture and generally of anæsthesia. The knee-chest, the Trendelenburg, or even the lateral position, with the hips strongly elevated, may be chosen. The first is the most effectual, but is not always practicable, under anæsthesia, without the aid of skilled assistants.

MANUAL METHOD. It must be remembered that much handling of the cord enfeebles the circulation and endangers the life of the child. The cord should be gently drawn to the front of the pelvis, where the reposition can most easily be effected. It is seldom that the prolapsed loops can be caught up in the hand and returned into the cavity of the uterus, or even pushed up inch by inch; as fast as one part is reposited another comes down. Yet success is sometimes possible by either of these plans. A method which has rarely failed in the writer's hands is this: The prolapsed loop is *loosely* twisted into a rope with great care to avoid interference with the circulation. It can then readily be replaced within the uterus. For retention, the woman may be kept in the latero-prone position, or the presenting pole be held in the brim till engaged. Occasional examinations are made per vaginam to make sure that the cord has not again slipped down. The fœtal pulse-rate is listened for at frequent intervals.

INSTRUMENTAL METHOD. A suitable instrument for repositing the prolapsed cord may be improvised with a large English catheter and a few feet of tape. A loop of the tape is made to encircle the cord loosely, and its free ends are attached to the tip of the catheter. The repositor, with a stylet inserted, is pushed into the uterus well up to the fundus, carrying the cord with it. The stylet is withdrawn and the catheter left to be expelled with the child. If preferred, the tape may be secured to the catheter by a bow-knot, which can be untied by pulling on the free end of the tape, and the cord thus be set free. The instrument may then be withdrawn. Return of the prolapse is prevented by pressure over the fundus, holding the presenting pole in the brim till firmly engaged.

Version or Forceps. Attempts at reposition failing, if the child is still living, immediate resort should be had to version or forceps. It is sometimes possible to save the child by rapid delivery without replacing the funis. The cord should first be disposed in front of that sacro-iliac joint opposite which there is most room.

Inversion of the Uterus.

Inversion of the uterus may be complete or partial. In complete inversion the organ is turned inside out and upside down. In partial inversion it presents a cup-shaped depression of greater or less depth at the fundus.

Frequency. Fortunately this accident is exceedingly rare. Winckel had never seen a case of complete inversion of the uterus in 20,000 cases of labor, nor had Braun in 250,000. In 192,000 labors at the Rotunda Hospital in Dublin, covering a period of nearly a century, one case was reported. The accident is doubtless more frequent in private than in hospital practice. Kehrer says it is believed to occur once in 2000 labors. Inversion of the uterus seldom takes place except at term, yet we have records of cases complicating miscarriage at six months, and Woodson reports a complete inversion following miscarriage at four months.

Varieties. The inversion may be acute or chronic. The latter variety concerns the gynecologist rather than the obstetrician, and will not be discussed in this connection. Three degrees of acute inversion are recognized:

1. A cup-shaped depression of the fundus, the latter approaching but not engaging in the os uteri. (Fig. 333.)
2. Partial inversion, the fundus protruding from the os. This is a true intussusception. (Fig. 334.)
3. Complete inversion (Fig. 335). In the latter variety, the uterus being turned inside out, the body of the organ may project from the

Ordinarily the pain is severe. It comes on abruptly, and is referred to the lower abdomen and the pelvis. The abdomen is painful to the touch. The hemorrhage may or may not be profuse, depending upon the degree of uterine relaxation. In exceptional cases it is insignificant; generally it is excessive. In the latter event the symptoms of acute anæmia are present.

The vesical and rectal symptoms are sometimes wholly absent. Occasionally there is retention of urine. Reeve reports two cases of complete inversion in which there was nothing in the patient's appearance or history to excite suspicion of the accident. Jewett has published a similar case.

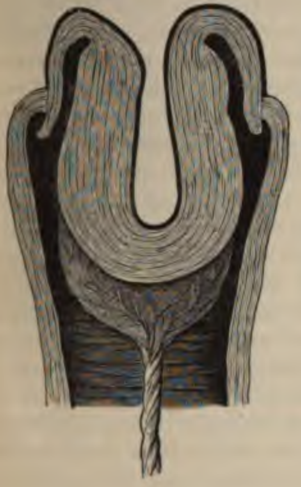
Diagnosis. As a rule, the acuteness and severity of the symptoms are such that they can scarcely fail to arrest the physician's attention should he be present when the inversion occurs. The diagnosis, however, must rest mainly on the physical signs. These are essentially the absence of the usual abdominal tumor, the presence of an intravaginal tumor, and the character of the tumor. It is indispensable to a satisfactory physical examination that the bladder and the rectum be empty. If the examiner is expert, the absence of the uterus in the abdomen may be determined beyond all possibility of doubt by the combined abdominal and vaginal, followed, if necessary, by the abdomino-rectal examination. The presence of the tumor in the vagina is obvious to the touch, sometimes to the eye. It must, however, be differentiated from a uterine polypus. The distinguishing points are the following: The inverted uterus presents a funnel-shaped depression at the cervix, which may generally be made out with one hand over the abdomen, the other making counter-pressure over the tumor within the vagina. If the inversion has existed for several days the abdomen may be too tense and too tender for satisfactory palpation; but this difficulty may be overcome by anæsthesia. In uterine inversion the implantation of the pedicle is circular, while in a polypus it is lateral. In the latter condition a uterine sound may be passed by the side of the pedicle into the uterine cavity, while in the former the sound will be arrested at the root of the pedicle. Sometimes it is possible by inspection with the aid of the speculum to detect upon the surface of the tumor the openings of the Fallopian tubes. The special contractility of the uterus may aid in differentiating. The possible presence of the placenta still adherent to the uterus must be borne in mind. Distinction from a polypus, however, is sometimes difficult.

Prognosis. Inversion of the uterus is among the most formidable complications of childbirth. Death may occur within a few hours fro hemorrhage and shock, or later from septicæmia. Rarely a chro inversion may exist for months or years. In exceptional instances spo taneous reposition has taken place, and recovery has been known to f low the separation of the organ by sloughing. The total mortality m fairly be stated at from one-quarter to one-third.

Treatment. PROPHYLAXIS. Puerperal inversion of the uterus is ge erally, if not always, a preventable accident. It is scarcely possible und a proper management of the third stage of labor. The prophylaxis co sists in the avoidance of traction upon the cord while the uterus relaxed, and of manipulation which may indent the fundus, and finall of properly directed efforts to bring about a prompt and persistent retrac and of the abdominal viscera pressing upon the fundus from above. (Fig. 332.) The inverted portion now acts as a foreign body, and being firmly grasped by the non-paralyzed segment of the uterus, it is carried further down at each contraction of the organ. A similar phenomenon is observed in intussusception of the bowels. Inversion arising in this manner is most likely to be incomplete.

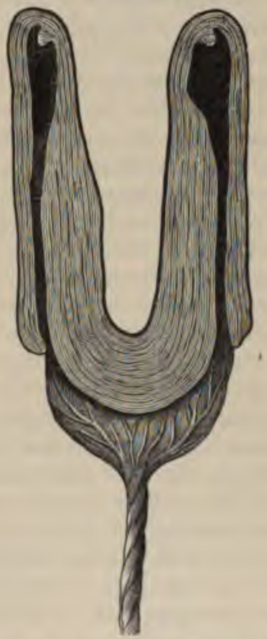
2. The accident may be caused by unskilful pressure of the obstetrician's hand on the fundus. Instances have been reported in which inversion of the uterus was produced by attempts at expressing the placenta directly after the completion of the second stage of labor. If, before sufficient time has elapsed for contraction to occur, forcible pressure be made on the fundus, inversion may result. Among the medical writings of the ancients mention is made of uterine inversion induced in this manner.

FIG. 334.



Partial inversion of uterus. (Modified from RIBEMONT-DESSAIGNES and LEPAGE.)

FIG. 335.



Complete inversion of uterus. (Modified from RIBEMONT-DESSAIGNES and LEPAGE.)

3. A common cause is believed to be traction upon the cord in the endeavor to remove the placenta shortly after the child is born. The relaxation of the uterus usually present at this time favors the inversion. In exceptional instances of short cord the fundus may be dragged down by the tension put upon the cord as the child is expelled.

Symptoms. The usual symptoms of inversion of the uterus are pain, hemorrhage, vesical and rectal tenesmus, and profound shock. The intensity of the symptoms, however, varies greatly in different cases.

Rupture of the Uterus.

Rupture of the uterus may occur in any portion of the organ, and during gestation, labor, or the puerperium. Laceration of the infravaginal portion of the cervix is an accident of little consequence; indeed, a tear of greater or less extent is apt to occur in all first labors. These lacerations are discussed elsewhere. Of an entirely different character are ruptures of the supravaginal portion of the cervix or of the body of the uterus. While spontaneous rupture of the uterus may take place in the later months of gestation or during the puerperal period, the vast majority of ruptures occur during the second stage of labor. In this connection will be discussed more especially ruptures of the body of the uterus occurring during childbirth.

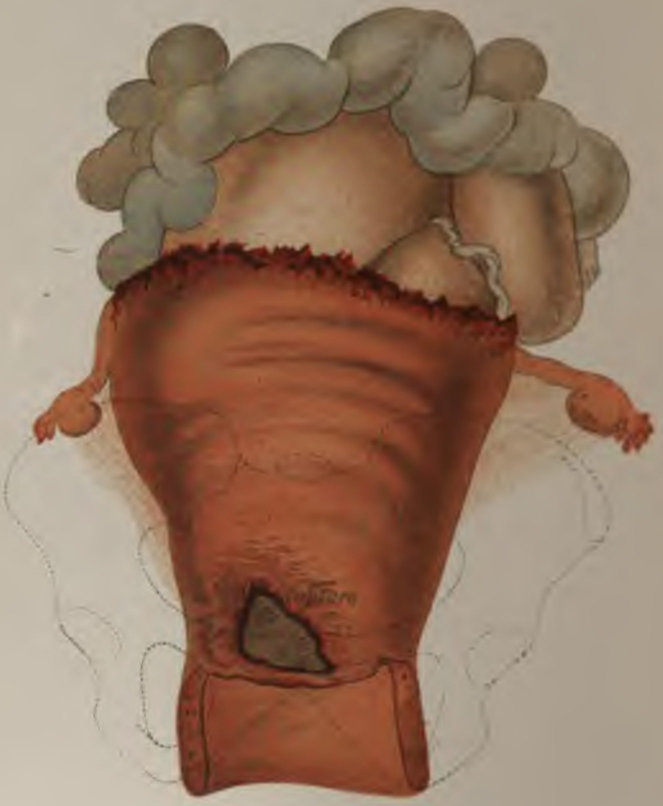
Frequency. Fortunately, uterine rupture is a rare accident. The frequency may be stated at 1 in about 4000 labors. Churchill, however, gives the proportion as 1 in 1331, Bumm 1 in 940; and Jolly estimates, from nearly one million cases, that the accident occurs once in 3400 labors. The latter authority found that in 573 cases of rupture of the uterus, 376 were spontaneous and 197 were traumatic. The percentage is large in countries where rachitis and osteomalacia are prevalent, pelvic deformity often being the predisposing cause of rupture of the uterus.

From the extreme reluctance which practitioners naturally have for publishing cases of this unfortunate accident occurring in private practice, estimates of its frequency must be derived mainly from the records of the large hospitals.

Pathological Anatomy. While rupture of the uterus may involve any portion of the organ, it usually begins in the inferior segment. This is accounted for by the greater distention and consequent thinning to which this portion of the uterus is subjected during labor, especially in labors attended with violent uterine contractions. The anterior and the posterior wall of the lower uterine segment, too, are exposed to injury by pressure between the bony prominences of the sacrum behind, or of the symphysis in front, and the child's head. Sometimes the vaginal portion of the neck is torn away in the form of a ring before the advancing head. Most frequently the seat of rupture is lateral. When rupture occurs at or near term, and is due to external violence, the superior portion of the anterior wall is usually the location of the injury. When the uterus is the seat of a neoplasm, either benign or malignant, the elasticity of that portion of the organ which is diseased is diminished, and rupture may occur along the edge of the degenerated tissue. Some authorities hold, however, that this want of elasticity affords greater resistance to intra-uterine pressure, and that, consequently, when the uterus is ruptured, the portion involved in the new growth is the last to give way.

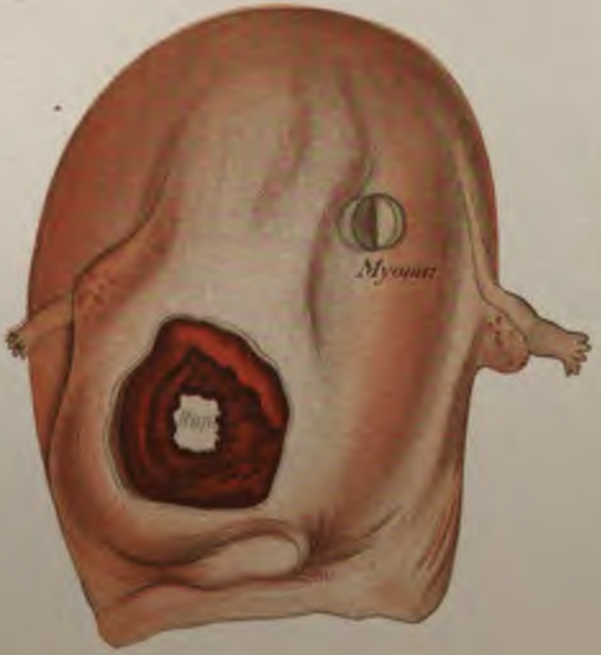
The extent, direction, and shape of the tear are subject to the widest possible variation. The extent of the injury varies in different cases from a small rent scarcely large enough to admit the finger tip to a laceration permitting the escape of the child and placenta into the abdominal cavity. The direction is most frequently vertical, sometimes transverse or oblique. It may involve the entire length of the uterus;

PLATE XXXII.

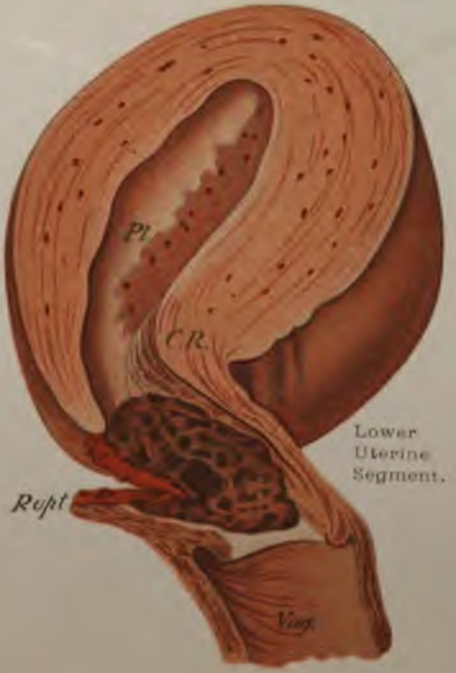


Rupture of Fundus, with Total Escape of Fœtus into Abdominal Cavity. Rupture also Near Cervix.

PLATE XXXIII.



Rupture of Uterus Due to [illegible] from Pressure of Promontory.



Transverse Rupture of Uterus, Resulting from Thinning of the Wall by Epithelioma.

frequently it invades the vagina, and in exceptional instances the bladder. Jewett has reported two cases in which the child escaped into the peritoneal cavity through a rent, most of which was in the posterior vaginal wall. Transverse tears may extend through the circumference of the organ. Rarely the tear is even and clean cut. Usually the edge of the wound presents a jagged and irregular appearance, owing to the contractility of the muscular fibres of the uterus.

If the patient survives the accident for forty-eight or seventy-two hours, there may be found post mortem a large quantity of blood in the abdominal cavity; indeed, the hemorrhage is often the cause of death. The tissues around the margin of the wound are frequently swollen and ecchymosed, and there may be patches of necrotic tissue. Where the uterus was primarily the seat of lesions favoring rupture evidence to that effect will be observed.

The rupture may be complete or partial. In *complete rupture* the tear involves both the muscularis and the peritoneum, opening the peritoneal cavity; in *incomplete rupture* the laceration extends through the muscular wall only, the serous covering remaining intact. In complete rupture loops of intestine may prolapse into the uterus, and even into the vagina. Infective peritonitis rapidly follows the extrusion of the fœtus and placenta into the peritoneum. The accident, it is scarcely necessary to say, is immediately fatal to the fœtus. The laxity with which the peritoneum is attached to the inferior wall of the uterus makes it possible for a rupture beginning in the supravaginal portion of the neck to extend upward for a considerable distance in the muscular layer of the uterus without laceration of its serous covering. Most frequently the tear in the serous covering takes place at the insertion of the broad ligament. In subserous lacerations a large effusion of blood may accumulate at the seat of the rent without the peritoneal cavity. The peritoneal coat may be ruptured, the muscular layer remaining intact. This form of laceration is possible during either pregnancy or labor when from any cause elasticity of the peritoneum has been impaired. In these rare instances hemorrhage and diffuse peritonitis may result.

Etiology. The causes of rupture of the uterus are: I. Predisposing and II. Determining.

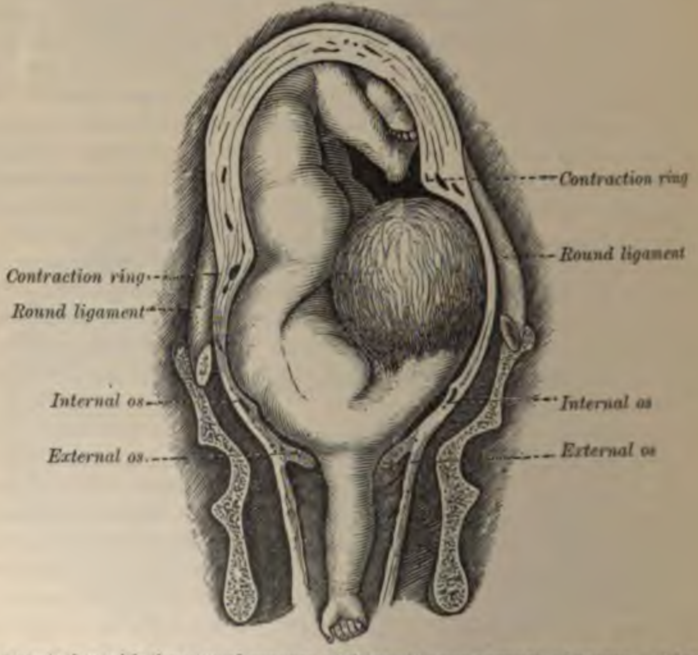
I. PREDISPOSING CAUSES. During pregnancy and at term the uterus becomes greatly distended, and its walls are softened and thinned. Conditions which lead to excessive distention of the uterus are hydramnios, multiple pregnancy, hydrocephalus, and those which lessen the resistance of the uterine wall. Multiparity, late primiparity, or systemic disease may act as predisposing causes. According to the statistics collected by Brand, of 546 cases of rupture, only 64 occurred in primiparæ. Since male children are ordinarily larger than female, sex, as suggested by Keever, may be a predisposing factor. He found that in twenty cases of rupture three-fourths were male children.

The influence which some form of degeneration of the uterine wall may exert as a predisposing cause of rupture is undoubtedly great, though clinical evidence to this effect is necessarily meagre. Traumatism of various sorts, as blows, falls, kicks, etc., may weaken the wall of the uterus at the site of injury. The muscular fibres of the uterus may be the seat of degenerative changes, calcareous, fatty, or apoplectiform, conditions which favor rupture. The weak point may be in the scar left by a former Cæsarean section. Malignant disease of the uterus exposes to rupture. A large growth in the uterus, as a submucous fibroid, may by its mechanical presence offer an obstacle to the expulsion of the child, and thus favor rupture. Malformation of the uterus predisposes to this accident. Rarely the uterus is perforated in cystic degeneration of the chorion. Pelvic deformity is one of the commonest of the predisposing causes of uterine rupture.

Other conditions which give rise to disproportion between the fœtus and the birth-canal, or which obstruct the birth, as marked uterine obliquity, malpresentations, and malpositions, may predispose. While rupture of the uterus rarely occurs before the membranes have broken, a case is recorded by Hamilton in which at the autopsy the lateral wall of the uterus was the seat of a tear of considerable extent, the membranes still being intact. Rupture of the puerperal uterus is due to sloughing or to a dissecting metritis.

II. DETERMINING CAUSES. The determining or exciting causes of rupture of the uterus may conveniently be grouped under two heads—

FIG. 336.



Arm presentation with threatened rupture of thinned lower segment of uterus. (Schroede

traumatism and excessive uterine contraction. Examples of the form class are blows, falls, and kicks. The prominence of the uterine tum at term increases the risk from external violence to which persons in walks of life are daily exposed. Rupture occurring from these caus concerns the general surgeon rather than the obstetrician. Of muc more frequent occurrence is perforation by the hand or instruments, an rupture from unskilful attempts at version, the high application of the forceps, prolonged attempts at separating a firmly adherent placenta, and other obstetric operations. Hess, from an extended experience, believes that spontaneous rupture of the uterus is an accident of great rarity, whereas the lacerations produced by rough manipulations are comparatively common. Probably the most important element in determining a rupture is excessive uterine retraction. The researches of Bandl, first published in 1875, have added much to our knowledge of this subject. He showed that the upper two-thirds only of the uterus is the contractile portion, the lower third taking no direct part in the expulsion of the fœtus. As labor progresses the upper portion of the uterus becomes thicker with each contraction, while the lower portion grows thinner and more distended. At the junction of the upper and lower segments there is formed a well-marked line of demarcation, which occasionally can be felt through the abdominal wall, the "contraction- or retraction-ring." If during a pain the presenting part meets with obstruction, as in contracted pelvis, or a shoulder presentation, or pelvic tumor, the lower segment of the uterus becomes excessively thinned until finally, under the influence of an unusually forcible contraction, rupture occurs. There can be no doubt that the injudicious exhibition of ergot has, not infrequently, been the cause of rupture. Meigs reports three cases, and Bedford four, traceable directly to this cause. Jolly collected thirty-three cases of uterine rupture in which ergot was given in large doses. In all cases of disproportion, whether referable to the fœtus or to the birth-canal, rupture may be caused in one of two ways: either as the direct result of excessive and prolonged contractions, or in consequence of compression of the uterine wall between the presenting part and the bony pelvis.

Diagnosis. In most cases of threatening rupture of the uterus certain premonitory symptoms may be observed. Excessive crampy pains in the lower abdomen may be felt, arising from overdistention or compression of the uterine wall. It is but reasonable to assume that when rupture is imminent the distress occasioned by undue stretching of the uterine walls will be greater and more persistent than in normal labor. Most significant of impending rupture is an abnormally high position of the retraction-ring, felt near the line of the umbilicus.

The occurrence of rupture of the uterus is made manifest by the following usually characteristic phenomena: In course of some obstetric manipulation, or perhaps during a violent expulsive effort, the patient is suddenly seized with intense pain, differing entirely from a normal labor-pain; this acute and cramp-like pain may be accompanied with a sound of tearing, audible in some cases to the bystanders as well as to the patient. The uterine contractions invariably cease, the patient complains of a dull continuous pain in the lower part of the abdomen, and the evidence of profound shock is quickly manifest. The face is pale, exhibits great suffering and apprehension, and becomes covered with a cold, clammy sweat; the respirations are rapid and shallow; the pulse small and imperceptible. Nausea, vomiting, and syncope frequently ensue. There is usually, but not always, some external hemorrhage. A physical examination reveals a change in the contour of the abdomen, and marked tenderness at the seat of rupture. If the rent in the uterus is large enough to permit the escape of the fœtus into the peritoneal cavity, the fœtal parts may be palpated through the abdominal wall, and apart from them may be felt the uterus, perhaps contracted down to the size of a fœtal head. Fœtal heart-sounds and active fœtal movements are absent. Upon vaginal examination the presenting part will be found to have receded, or, possibly, some other portion of the child may be encountered, or a loop of intestine may be found prolapsed. If one or two fingers or the entire hand are introduced into the uterus, the site of the rupture may easily be detected, and the diagnosis confirmed. Some writers have called attention to the emphysematous condition of the abdominal walls arising from the entrance of air into the cellular tissue, and to a hypogastric tumor formed by the escaped blood.

While the characteristic symptoms of rupture are usually present in exceptional cases, neither shock, external hemorrhage, cessation of the uterine contractions, nor marked local pain is present, and the true condition can be determined only at the autopsy. In this connection the following statistics from Jolly are of interest: Of 580 cases of rupture the contractions ceased in 256; there was external hemorrhage in 148, collapse in 179, retraction of the presenting part in 146, and abdominal pain in 133. The fœtal limbs could be felt through the abdominal wall in 77 cases.

The practitioner will do well to view with suspicion any abnormal pain occurring during the second stage of labor, especially if accompanied with shock. Reasonable suspicion of rupture calls for immediate extraction of fœtus and placenta and a thorough exploration of the uterine wall with the hand in the uterus.

Prognosis. In complete rupture of the uterus without radical treatment the prognosis is exceedingly grave. The outcome for the child is almost necessarily fatal, 92 per cent. of all cases resulting in the death of the fœtus. The immediate cause of death is asphyxia. The maternal mortality is not so high: probably under the best modern treatment about 60 per cent. of the women perish. Yet unrelieved the mortality is not less than 90 to 95 per cent.

In the treatment of *incomplete rupture* child and placenta should immediately be delivered. Forceps or podalic version may be chosen, but the latter is seldom permissible. When extraction by other means is likely to be difficult, delivery by perforation in the grasp of the cephalotribe is generally advisable. When the child is dead the latter procedure is clearly indicated. If the placenta has escaped into the peritoneum, it may rarely be extracted through the rent by the hand in the uterus with the aid of gentle traction upon the cord.

After extraction of child, placenta, and blood-clots the location and extent of the rent should be determined with the hand in the uterus. In incomplete rupture of moderate extent and limited to the upper uterine segment, no other treatment usually is required than to promote firm uterine contractions.

In subperitoneal lacerations involving the lower segment of the uterus an extraperitoneal hæmatoma is generally developed. Such cases may be trusted to thorough evacuation of blood-clots, the control of arterial hemorrhage from the cervix by hæmostatic suture, and a gauze drain loosely placed in the rent. The gauze may be removed in twenty-four hours.

The death of the mother may result from shock, from primary or secondary hemorrhage, or from sepsis. More than one-half of the deaths occur within the first forty-eight hours after the injury. In pre-antiseptic days the outlook was still more gloomy, but with the increasing knowledge of abdominal surgery, and the better operative technique of the present day, the results have much improved. The following statistics from Schultze show the percentage of recoveries under different methods of treatment:

Complete rupture without treatment, 20.2 per cent.

Complete rupture treated with drainage, 36 per cent.

Complete rupture treated by laparotomy, 44.7 per cent.

As will be seen, the best results are obtained by the employment of surgical measures, and the prognosis is in some measure dependent on the promptness with which resort is had to operative interference.

In incomplete rupture the consequences are less serious. As a rule, good results may be expected with the arrest of hemorrhage, complete evacuation of blood-clots, and proper drainage.

Treatment. PROPHYLAXIS. Essential to the *prophylaxis* of uterine rupture is prompt recognition of conditions which may act as predisposing causes. In the presence of vigorous uterine contractions with no progress, excessive thinness of the lower uterine segment is to be suspected and examined for. When Bandl's ring is felt more than half-way from the pubes to the umbilicus labor should be ended as speedily as possible. The procedure to be adopted will depend upon the conditions present. In all cases an anæsthetic, and preferably chloroform, should be administered to the full surgical degree, to secure complete relaxation of the uterus. The uterus must be emptied promptly and with the least possible violence. In transverse presentation version is scarcely permissible, and decapitation will generally be required. In head presentation, if the child is living and the head has already engaged, the cautious use of forceps should be tried; but if difficulty is experienced in applying the blades the attempt should be abandoned. Two methods of procedure are then left to the obstetrician—Cæsarean section or craniotomy on the living child. It is needless to say that the latter alternative should be adopted only as a last resort, if the child is viable.

When the proof of the child's death is conclusive embryotomy is clearly indicated. Podalic version should never be attempted, owing to the great danger of precipitating rupture of the overstretched uterine walls.

Treatment of Complete Rupture. (*a*) *Drainage.* In complete rupture drainage may suffice when the rent is situated posteriorly if the injury is not extensive, if child and placenta have been extracted through the natural passages, and there is reason to believe that there is little or no blood in the peritoneum and that the uterus is not infected. Prolapsed loops of intestine are reposited, and a drain of wicking or of loose gauze rope is pushed through the rent, barely entering the peritoneum. The drain is removed in one or two days. Ruptures of the anterior wall are obviously not amenable to drainage.

(*b*) *Cœliotomy.* The abdomen should be opened, if the condition of the patient permits, in complete ruptures situated anteriorly, in extensive laceration of the posterior wall involving the peritoneum, in all cases in which the child has wholly escaped into the peritoneum or in which the child has been dead for several hours. Abdominal section is indicated, too, when there is much blood in the peritoneum or the uterus is presumably infected. In the presence of extensive or complicated injuries or of probable infection partial or complete hysterectomy offers the best chance of recovery. When there is reason to believe that the uterus is aseptic, clean-cut lacerations of moderate extent may be closed by two or three layers of suture, as the wound is closed in Cæsarean section. The usual toilet of the peritoneum must be carried out, and if thought best a gauze drain through the posterior vaginal wall may be left for one or two days.

Rupture of the Symphysis Pubis.

Swelling and softening of the ligaments and cartilages of the pelvic joints occur in slight degree during pregnancy, especially at the symphysis pubis. The softening is usually so slight as to give rise to little or no appreciable separation; exceptionally it is sufficient to result in perceptible mobility of the pubic bones upon each other. According to Stoltz, the separation may result from excessive softening of the joint-structures or from direct violence during operative efforts at delivery, whether complicated or not with excessive relaxation of the joint-structures: the former accident is known as relaxation of the joint; the latter, occurring during labor, as rupture of the symphysis.

Causes. The predisposing causes of this accident are osteomalacia, rachitis, syphilis, and tuberculosis. Any profound cachexia may favor pelvic contraction. Unusually large fœtal head or faulty presentation predisposes to rupture of pelvic articulations. Spontaneous rupture of the symphysis is rarely possible. In the great majority of instances the rupture is due to forceps. Excessive or misdirected traction is most frequently responsible for the injury. Of twenty-three cases of rupture of the symphysis collected by Havajewicz forceps had been used in eighteen.

Diagnosis. When rupture of the symphysis occurs during labor the patient usually experiences a sharp pain in the joint. There may be a sensation of tearing. A sudden advance of the presenting part usually attends the rupture. Sometimes the separation is accompanied by a crackling sound perceptible to the attendants, but it is not always present, nor is it pathognomonic, as the same sound may be produced by the cranial bones gliding over one another or over a prominence of the pelvis. Usually the mobility of the bones is perceptible to the patient on turning in bed during convalescence. In rare instances the patient may be unaware of the injury of the symphysis until she attempts to walk. In extreme separation of the pubic bones there occurs some degree of injury to one or both of the sacro-iliac articulations.

The diagnosis is made by direct examination. With the index-finger introduced within the vagina behind the symphysis, and the thumb in front, the separation and mobility of the bones may readily be made out. The looseness of the joints is detected by alternately flexing and extending one thigh, and by rotating it outward, while the other is firmly held by an assistant. After the patient is able to leave the bed the slightest mobility is appreciable by examination in the standing posture, the patient being required to rest her weight on one and the other foot alternately.

The Prognosis may be grave if the vagina or bladder is torn. It is extremely so if the peritoneum is invaded by the laceration. In neglected cases permanent mobility of the joint may remain, with partial or complete inability to walk.

Treatment. The treatment of rupture or relaxation of the symphysis when discovered at the time of the injury consists in immobilizing the joint for from four to six weeks by means of a firm pelvic bandage. The patient in the mean time must be kept in bed. The hammock bed of Quierel or of Ayres, as employed in the after-treatment of symphyseotomy, may be utilized. Laceration of the soft parts should be repaired by immediate suture. Neglected cases may be successfully treated by vivifying the articular surfaces with a suitable instrument passed subcutaneously, and immobilizing the joint with a firm spica bandage, with rest in bed for a month or more. If pus forms, the abscess should be evacuated promptly. Wiring the bones together is not necessary, and yields no better result.

Hæmatoma of the Vulva and Vagina.

Extravasation of blood into the cellular tissue of the vagina and vulva occurs most frequently in the labia majora. Sometimes the primary seat of the effusion is in the labia minora. Rarely the hemorrhage takes place into the paravaginal tissues or the perineum. The hemorrhage may be venous or arterial, usually the former. The extravasation begins generally during the second stage of labor, rarely after delivery. The tumor may become large enough to obstruct the birth, yet it seldom attains any considerable size before the expulsion of the fœtus. The swelling is most commonly observed at one side of the vulva; when within the vagina it is located either upon the posterior or the lateral aspect. Labarie has shown that the site of tumor is dependent upon the anatomical structure of the part affected. When the hemorrhage occurs beneath the skin of the perineal region the extravasation may extend down the thighs or upward on the abdomen; when below the superficial fascia it remains localized. Extravasations which occur beneath the deep fascia of the perineum may extend into either iliac fossa. When the blood is effused between the deep fascia and the peritoneum a hæmatoma may form in the abdomen, extending as high as the umbilicus. When either lateral or posterior wall of the vagina is the seat of the extravasation it is limited in extent by the dense fibrous layer surrounding the structure, and remains localized.

Frequency. The accident is rare. Winckel estimates the frequency at 1 in 1600 labors, and Charpentier 1 in 2000. These estimates do not include cases of comparatively frequent occurrence in which there may be a slight capillary oozing, due to a varicose condition of the superficial veins of the vulva.

Etiology. The principal predisposing cause of hæmatoma of the vulva or vagina is the obstruction to the local circulation occasioned by advanced pregnancy. Other predisposing causes are deformity of the pelvis, disproportion between the fœtus and the birth-canal, circulatory disease, or morbid changes in the blood.

Anything which acts to increase the pressure in the already greatly distended veins may precipitate their rupture. Common exciting causes are blows, falls, or violent concussion, the unskilful use of the forceps, awkward attempts at version, and unusual size of the fœtus. As a rule, the accident is spontaneous.

Symptoms. The first to attract attention usually is a swelling either at one side of the vulva or within the vagina. The tumor appears most frequently during the severe pains of the second stage of labor, and usually develops rapidly. Upon examination there will be found a tumor, smooth, circumscribed when small, but diffuse when very extensive, and imparting to the finger an elastic feel. Fluctuation may or may not be present. The tumor is generally of a dark, livid color, and the ecchymosis may involve ultimately a large area around it. If the formation of the thrombus occurs before the delivery of the child, it may obstruct the birth. When the tumor develops at the close of the second stage of labor its presence may interfere with the expulsion of the placenta, or, later, with the lochial discharge. With extensive extravasation the symptoms of internal hemorrhage are present, namely, feeble, rapid pulse, pallor, cold, clammy sweat, dimness of vision, shallow respiration, etc. Finally, if the tumor ruptures, external hemorrhage of greater or less degree may be added to the foregoing symptoms.

Prognosis. Hæmatoma in this situation may terminate as do hæmatomata in other localities: it may be absorbed; it may become encysted and undergo fatty or calcareous degeneration; it may rupture subsequently, or become infected and suppurate. Suppuration is more likely to follow a spontaneous rupture than an open incision. The prognosis is generally good under proper treatment. The outlook is more favorable when the tumor appears after delivery. The dangers to which the woman is exposed are hemorrhage, sepsis, and those of instrumental or manual delivery.

Treatment. The prophylactic treatment in the presence of undue congestion of the venous circulation, or of small extravasations during the last weeks of pregnancy, consists in keeping the patient in the horizontal position for the most of the time. At labor measures to facilitate labor are indicated. Usually no premonitory symptoms are observed.

The active treatment will vary according to the size of the tumor, the amount of pressure it exerts, and the time of its appearance. When the tumor appears before delivery, and by its size renders the passage of the child's head impossible without spontaneous rupture, an anæsthetic should be administered, the tumor should be freely incised, all clot turned out, the cavity irrigated with a weak antiseptic solution or wit sterilized water, and the hemorrhage controlled by a firm gauze pac and, if required, hæmostatic sutures. The subsequent treatment w consist in daily irrigation and repacking the wound with gauze, allow the cavity to heal from the bottom by granulation. If the thromb does not appear until after delivery, it is better treated by compression with a view to promoting absorption. The case should, however, be watched carefully, and, if spontaneous rupture threatens, the tumor should be opened and treated as detailed above. The cavity, as a rule, becomes septic. Extreme care is needed to prevent systemic infection. In case of excessive blood-loss the acute anæmia is to be treated as in other hemorrhages.

CHAPTER XXII.

THE HEMORRHAGES.

Hemorrhage from Partial Separation of an Abnormally Situated Placenta—Placenta Prævia.

NORMALLY the implantation of the placenta is wholly within the upper uterine segment, and its attachment remains undisturbed till the fœtus is expelled. When its site encroaches upon that portion of the uterus which undergoes dilatation in the first stage of labor, the placenta is of necessity partially detached at the onset of labor or in course of the partial expansion of the lower uterine segment, which takes place during the later weeks of gestation, and hemorrhage follows from the torn blood-vessels. To this abnormal situation of the placenta is given the name *Placenta Prævia,* since the placenta lies partly in advance of the fœtus. To the form of hemorrhage occurring from prævial placenta, Rigby applied the term *unavoidable* hemorrhage, in distinction from that proceeding from partial detachment of the normally situated placenta, and which he called *accidental hemorrhage.*

Varieties. Four varieties are usually described: *Lateral,* in which the placenta extends into the lower uterine segment, but not to the internal os; *marginal,* in which it barely reaches the internal os; *partial,* in which the placenta is so placed that it partly overlaps the os after full dilatation; and *complete,* in which it will wholly cover the fully dilated os. The term *central* placenta prævia is sometimes employed to designate a central implantation upon the lower uterine segment. But these terms are not all accurately descriptive, and the multiplication of varieties is needlessly confusing. It is sufficient to make two classes of cases: *partial* and *complete* placenta prævia.

The Source of the Hemorrhage is the uncovered portion of the placental site, sometimes the placenta as well. Hofmeier has shown that the lower uterine segment is supplied by a branch of the uterine artery which descends from the upper segment. The arrest of hemorrhage from the lower portion of the uterus after labor is largely due to the retraction of the contractile upper segment, diminishing the blood-supply to the lower.

Before the expulsion of the fœtus, retraction being incomplete or absent, there is a free exchange of blood between the active and the passive segments; hence the hemorrhage from the bared portion of the obstetric cervix in placenta prævia. A placental cotyledon may bleed while partially detached, but after complete separation its vessels are obliterated by coagula.

Frequency. The frequency of prævial insertion of the placenta is usually stated at about 1 in 1000 cases. This estimate corresponds very nearly with the results of Müller's investigation, who found 813 cases reported in 876,432 labors, and with the average statistics afforded by lying-in hospitals. The frequency is several times greater in multiparæ than in women pregnant for the first time.

Structural Anomalies. Owing to the comparative thinness of the decidua in the region of the os internum the prævial portion is less perfectly developed than other parts of the placenta. This gives rise to unevenness in thickness and to irregularity of form. Sometimes the placenta presents a horseshoe shape. There may be isolated cotyledons which are almost completely separate from the main structure.

The thinned portion of the placenta has a comparatively insecure attachment, a fact which increases the tendency to hemorrhage. The rest of the organ is often abnormally adherent. Müller found adhesion in 54 out of 142 cases of placenta prævia. The insertion of the cord is usually eccentric.

Etiology. The causes of placenta prævia are not definitely known. Probable causes are conditions leading to tardy fixation of the ovum, permitting it to fall to the lower uterine segment. Atrophy of the decidua, relaxation and subinvolution of the uterus, chronic endometritis, new growths and malformations of the uterus are, accordingly, believed to be factors in the etiology. Consistently with this hypothesis low implantation of the placenta is most frequently met in women who have borne several children. It is said to occur oftener in multiple than in single fœtation.

Müller finds the cause in arrested abortion. The ovum, he thinks, may be partially separated and displaced by uterine contractions, and find secondary attachment lower down.

Osiander suggests that the influence of gravity should be taken into account in explaining low fixation.

Recently Hofmeier and Kaltenbach have proposed the theory that the anomaly may originate from the development of the placenta over the decidua reflexa of the lower pole of the ovum. Their views have not, however, met with universal acceptance.

Hart maintains that the vicious insertion is primary. He believes that the human ovum can become engrafted only on a surface denuded of epithelium, and that the ovum may exceptionally meet with such a surface only in the lower uterine segment. Kaltenbach's objection that the ovum could not find lodgement near the cervix, but would rather escape through it and be lost, he thinks, does not hold, since the os internum is practically obliterated by folds of the hypertrophied decidua. Ingleby found a low insertion of the Fallopian tubes in two remarkable cases, in each of which placenta prævia had occurred in several successive pregnancies.

Symptoms. Usually there are no symptoms in the earlier months of pregnancy; yet placenta prævia is frequently an unrecognized cause of abortion. Generally the first indication is a sudden hemorrhage of greater or less severity. This may occur at any period of gestation, but is seldom noted except in the later months. The liability to hemorrhage increases with each succeeding month of pregnancy. Much bleeding from this cause is rare before the seventh month; in the vast majority of instances the first attack is observed in the eighth or ninth. It comes on with no premonition, and generally without obvious exciting cause. Exceptionally the first hemorrhage follows some unusual muscular exertion. The amount of blood-loss varies with the conditions of the individual case. It is proportionate to the extent of placental separation.

It is greater usually the more nearly the prævial attachment is complete and the nearer to term the hemorrhage; yet a marginal placenta prævia may exceptionally give rise to copious flooding. From one to three pints of blood may be lost in the first attack in pregnancy, and this quantity may be greatly exceeded during labor. Characteristic of this form of hemorrhage is the fact that the flooding is most profuse in the intervals between the pains. During the height of the pain the blood-supply to the torn vessels is almost wholly interrupted by the contraction of the upper uterine segment. The first hemorrhage, especially if it occurs during labor, may go on to a fatal termination, or it may cease to be renewed at any day or hour on further separation of the placenta. But it is not alone the copious outpour of blood that is dangerous. In a certain proportion of cases the bleeding is slight but persistent, and if neglected, though at no time large in amount, it may ultimately place the patient's life in grave peril. To the clinical picture are frequently added the signs of acute anæmia; these are: pallor, perspiration, skin cold and clammy, respiration irregular, sighing, sobbing, yawning, pulse rapid, thready, compressible; thirst, jactitation, tinnitus aurium, air-hunger, nausea, dimness of vision, and syncope.

Diagnosis. Hemorrhage during pregnancy, and especially in the later months, demands immediate investigation to ascertain its cause. Recurring hemorrhages near term are generally due to villous insertion of the placenta. This form of hemorrhage must be distinguished from so-called "accidental hemorrhage." The diagnosis must rest on the *physical signs.*

Abdominal Signs. Frequently the location of the placenta, when the implantation is partly on the anterior wall of the uterus, may be made out by palpation over the abdomen. Sometimes the edge of the placenta presents a resisting ring perceptible by the abdominal touch. Within the placental area the fœtal parts are felt indistinctly, owing to the interposition of the placenta between the fœtus and the examining fingers, while elsewhere they are more readily made out.

Vaginal Signs. In placenta prævia ballottement is wanting or difficult, as is also the recognition of the fœtal parts by the vaginal touch. Owing to the interposition of the spongy placental tissue between the child's head and the fingers of the examiner, bogginess of the cervix, usually referred to as evidence of prævial insertion of the placenta, is not always sufficiently characteristic to be of diagnostic value. The only pathognomonic sign of placenta prævia is the recognition of the abnormal situation of the placenta by the examining finger passed within the os. If labor has begun, the os will be found soft and patulous, and upon introducing the finger through the cervix the placenta may be identified by its characteristic stringy feel. To distinguish a complete from an incomplete placenta prævia, the finger is passed well on each side of the cervix, feeling for the margin of the placenta: the fully dilated os is entirely surrounded by placental tissue, placenta prævia is complete; if the finger can be introduced betwe the margin of the placenta and the wall of the cervix, the condition one of incomplete placenta prævia.

Prognosis. Placenta prævia is a dangerous complication of pregnanc and labor for both mother and child. Much depends, however, on th degree to which the placenta is prævia, and in general the mortality is capable of great reduction under proper treatment. Churchill and Read place the maternal death-rate at from 25 to 33 per cent. In 67 cases recorded by Barnes, 8.8 per cent. of the mothers were lost. Müller's estimate of the mortality is 23 per cent. for the mothers and 64 per cent. for the children. In 61 cases Murphy had but 2 maternal deaths. Winckel thinks that not more than 5 or 10 per cent. of the mothers should be lost. In 739 collected cases there were 57 maternal deaths in incomplete, and 109 in complete placenta prævia. It is the writer's conviction that under modern methods of treatment the maternal mortality should not exceed the limit stated by Winckel, and the fœtal should not be more than 50 per cent. The risks to which the mother is exposed are not only those of the primary hemorrhage, but also those of operative interference and of the sequelæ. Malpresentations and malpositions of the fœtus and prolapsus funis are more frequent in placenta prævia than in normal placental implantation, and there is greater risk of infection during labor, of post-partum hemorrhage, and of thrombotic affections.

Treatment. The chief element of danger in placenta prævia is hemorrhage, and the control of hemorrhage is, therefore, the principal indication in the treatment. Here, as in general, while the child's life must not be undervalued, the interests of the mother are paramount. It will be convenient to consider the management of placenta prævia under the following heads:

(1) BEFORE THE FŒTUS IS VIABLE. The death of the mother, by reason of vicious insertion of the placenta, is extremely rare before the end of the seventh month of gestation. A partially expectant plan of treatment is usually permissible till the viable period is reached, in the hope of saving the child. This course is the more justifiable in hospital practice, where the woman can be kept under close observation, and measures for the control of hemorrhage can be promptly enforced should the occasion arise. Quiet, and if need be, rest in bed must be enjoined. The avoidance of much muscular exertion and of the causes of pelvic congestion, including coitus, is imperative. Vaginal douches of hot water and vinegar, as advised by Winckel, are of doubtful utility. They are liable to defeat their own object by provoking uterine contractions.

If the fœtus is dead the uterus should immediately be emptied. The latter treatment is usually indicated, too, if the hemorrhage is profuse or persistent.

(2) AFTER THE FŒTUS IS VIABLE. Nearly all the fatal terminations in placenta prævia occur after the seventh month of pregnancy. The development of the utero-placental circulation increases with each succeeding month, and the danger is greater the nearer the case is to term. In the later weeks of gestation the woman is constantly exposed to the risk of hemorrhage, which may go to a fatal extent before medical aid can reach her. In all except simple marginal placenta prævia, with little or no hemorrhage, the pregnancy should be terminated immediately the period of full fœtal viability is reached, if the condition has been discovered. Moreover, it is imperative that the physician remain with the patient till labor is complete.

If the development of the fœtus has passed the seventh month, its chances for survival are fully as good by premature evacuation of the uterus as by waiting till repeated hemorrhages have occurred, since, after much bleeding, the danger from asphyxia is exceedingly great.

Management of Labor. The induction of labor is conducted in accordance with the usual rules. Krause's method—passing one or two bougies between the membranes and the uterine wall—may be elected when time permits. A water-bag may also be placed in the cervix for the double purpose of preventing hemorrhage and of provoking uterine contractions. When more rapid delivery is indicated, the cervix should be dilated by the use of the water-bag till the os internum is effaced. The dilatation may then be completed by the manual method. A firm abdominal binder is applied as a safeguard against the accumulation of blood in the uterus. Measures for controlling hemorrhage during labor are the following:

RUPTURE OF THE MEMBRANES IN PARTIAL DETACHMENT OF THE PLACENTA. In mere marginal placenta prævia the hemorrhage may frequently be controlled by rupturing the membranes, and, if necessary, stimulating the uterus to contract. On escape of the waters the fœtus is driven down by the uterine contractions and the bleeding is partially or wholly arrested by the pressure of the presenting part. An abdominal bandage is a valuable aid for maintaining this pressure. This procedure usually suffices in the class of cases referred to, and it has the advantage of simplicity. The progress of dilatation is somewhat retarded, but that is a matter of minor importance in comparison with the effects of much blood loss. The method is suited, however, only to cases in which the placental insertion encroaches but little upon the dilating zone of the uterus. It is positively contraindicated in conditions which may necessitate version.

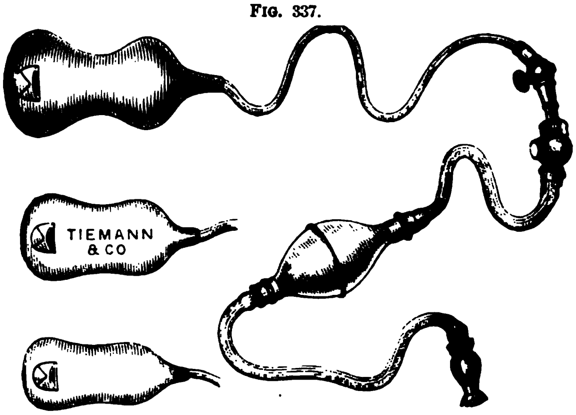
In addition to the perforation of the bag of waters, the presenting edge of the placenta should be separated from the lower uterine segment. The finger is passed through the cervix and the placental margin peeled up as far as the finger can reach easily. This favors retraction of the lower uterine segment and ligation of the torn vessels.

Should the bleeding still continue, a water-bag may be introduced, or when the dilatation is sufficient the forceps may be applied, if the vertex presents, and gentle traction be made to hold the head in the lower uterine segment. If the breech presents, one or both feet should be brought down as soon as the dilatation permits.

VAGINAL TAMPONADE. The vaginal tamponade is a valuable measure in cases in which there is hemorrhage with little or no dilatation of the cervix. The vaginal tampon, if it is properly applied and the uterus is supported by an abdominal binder, effectually controls the bleeding. The method of procedure is as follows: The bladder and the rectum should be empty. The Sims position is best, since in this posture the uterus falls toward the diaphragm and the vagina becomes fully distended with air when the pelvic floor is retracted with the speculum. The material for the tampon may be absorbent cotton or strip gauze, either plain or impregnated with iodoform or with oxide of zinc. The gauze has the advantage that it may easily be removed. The strips may be three or four inches in width. Whatever the material, it should be wet, in order to pack firmly. If the vagina is healthy and h not been infected by previous manipulations, no preliminary internal cleansing is necessary. In all other respects the usual antiseptic precautions must be observed. The material used for the vaginal tamponade must be aseptic; it is not necessary that it be antiseptic. No harm will be done, however, by impregnating it with some feebly toxic antiseptic. Mercurials are especially unsuitable for the purpose, owing to the danger of intoxication. If absorbent cotton is to be used for the tampon, twenty or thirty pledgets of the size of an English walnut should be in readiness. The patient is placed in Sims's position; a Sims speculum is introduced and held by an assistant. A convenient forceps for carrying the cotton balls is a straight Keith. The first pledget is placed behind the cervix, the next in front of the cervix, then one at each side. The intervening spaces are filled, and a second layer packed on the first. This is continued until the vagina is filled and the packing protrudes at the vulva. A pad of absorbent cotton is placed over the external genitals, and over this a firmly applied T bandage, which holds the tampons securely in place. If gauze is used it is packed in similar manner. The vaginal tampon is removed in eight to twelve hours, by which time the labor will in most cases have progressed sufficiently to be managed by other means. Should there still be bleeding, and the dilatation not have progressed far enough to efface the os internum, the packing may be renewed.

CERVICAL TAMPONADE. Equally efficient for the control of bleeding in placenta prævia during the beginning dilatation of the cervix is the complete occlusion of the cervical canal. This is effected by means of an elastic bag, which is introduced within the cervix and distended till the canal is successfully plugged. Available for this purpose are the fiddle-shaped bags of Barnes and of McLean, that of Tarnier, and the Champetier de Ribes ballon. A tube is attached to the bag through which the latter may be filled. For introduction of the dilating bags the patient may lie in the lithotomy position, the cervix being held well forward toward the pubes by means of a volsella caught in the anterior lip. One or two fingers are introduced within the vagina and the instrument

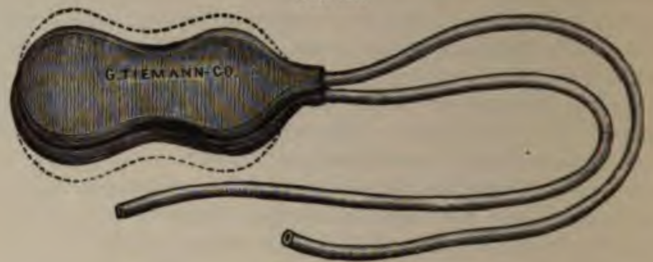
FIG. 337.



Barnes's dilating water-bags.

passed on these as a guide. The Sims position, however, is usually to be preferred. With the perineum retracted by means of a Sims speculum,

FIG. 338.


G. TIEMANN-CO.

McLean's bag.

and the cervix drawn forward, the os externum is readily brought into view. The dilating bag is rolled snugly into a cylindrical shape, seized with a long forceps, and lodged in the cervix. The forceps is then withdrawn and the bag distended. As a precaution against infection, should the bag accidentally be ruptured, boiled water or a mild antiseptic solution should be used for filling the bag. Air is unsuitable, owing to the risk of air embolism should the bag burst. The water is injected with a Davidson or similar bulb-syringe provided with a nozzle which fits the tube. As a precaution against overdistention the operator should know by previous trial how many bulbfuls are required to expand the bag to its limit. A rigid asepsis must, of course, be observed.

The cervical tampon has the double effect of controlling hemorrhage and at the same time promoting the dilatation of the cervix more effectually than does the vaginal packing. It has the advantage over the latter of causing less discomfort to the patient. When thought necessary both these measures may be employed. As a rule, they are to be replaced by other measures after the os internum is effaced. This is usually accomplished in at most eight or ten hours. Yet, when time permits, the labor may satisfactorily be completed with the aid of the dilating water-bag. The Champetier de Ribes bag is especially to be recommended after the dilatation of the cervix is well established. In the interest of asepsis it is best introduced within the amniotic sac, since direct contact of the bag with the bared surface of the uterus is thus avoided.

MANUAL DILATATION. Manual dilatation, or the so-called *accouchement forcé*, which has recently been advocated by Fournier and other authorities for the treatment of placenta prævia, is seldom permissible, except for completing the canalization of the utero-cervical zone after it is already well advanced. To a woman who has already sustained much blood-loss, forcible and rapid dilatation of the cervix *ab initio* is dangerous, owing to the shock involved. A considerable hemorrhage must necessarily occur during the dilatation, and the fingers in the cervix afford a very imperfect means for controlling it. The danger, too, of uterine rupture and of infection is increased in low implantation of the placenta, and this is an objection to *accouchement forcé*.

PODALIC VERSION. One of the most effectual measures for the control of hemorrhage in placenta prævia is podalic version, and no metho has yielded better results. With one or both feet brought down the fœtus serves as a conical plug, which is forced down or can be drawn down as fast as the dilatation progresses. The cervix is thus securely tamponed during the entire course of the birth. Lomer, of Berlin, reports a maternal mortality of 4½ per cent. in 101 cases treated by version. It must not be forgotten, however, that any kind of violent interference is unsafe when the woman has lost much blood. If, therefore, much bleeding has occurred, version is to be undertaken only when little difficulty is likely to be encountered.

In most cases it is a grave mistake to add the shock of immediate delivery to that of version. The excellent results of version in placenta prævia have been obtained only when the operation has not been followed by immediate extraction. Either the external, the bipolar, or the internal method may be chosen, according to the conditions present. External version before labor is exceptionally possible. The bipolar method of Braxton Hicks has the advantage over internal version that it can be performed early in the labor, as soon as one or two fingers can be passed through the os uteri, and there is less danger of infection than when the whole hand is introduced. The fingers passed through the membranes, one or both feet are seized with the hand and brought down. When the placental margin cannot readily be reached, in emergency the placenta may be perforated and the feet brought down. With the fœtus inverted the hemorrhage is completely under control, and the delivery can usually safely be left to nature. Rarely it may be necessary to assist the birth, taking plenty of time, delivering very slowly.

For the full technique of the different methods of version the reader is referred to the chapter on Obstetric Surgery.

OTHER METHODS. *Partial Separation of the Placenta.* Separation of the presenting portion of the placenta, as proposed by Barnes, often suffices in marginal implantation. It permits retraction of the zone uncovered. In most instances of this form of placenta prævia no other treatment will be required. One or two fingers are passed between the placental edge and the uterine wall, and the margin of the placenta is peeled up by sweeping the fingers laterally. The detachment should be carried far enough to uncover completely the dilating zone of the uterus. An abdominal binder should be applied.

Complete Separation of the Placenta, as advised by Simpson, is applicable in case the child is dead or not yet viable.

PRECAUTIONS. It must not be forgotten that the essential object of treatment in placenta prævia is the control of hemorrhage. Hemorrhage under control, there is no occasion, as a rule, for active interference. Violent measures are especially contraindicated in the acute anæmia which often obtains in this class of cases at labor. Very little shock in such conditions will frequently precipitate a fatal issue. A large proportion of deaths in placenta prævia is distinctly chargeable to over-zealous interference.

Owing to the low placental site and the intra-uterine manipulations usually required, the risk of sepsis, too, is much greater than in ordinary labors. Precautions against sepsis must rigidly be observed.

Post-partal hemorrhage is of frequent occurrence. The vessels of the placental site are not so securely ligated after labor, when the implantation is on the lower and less contractile portion of the uterus, as in normal conditions. The amount of post-partum flow must always be watched. Retraction of the uterus should promptly be secured and rigidly maintained. Ergot should be given for two or three days after labor.

Hemorrhage from Premature Separation of a Normally Situated Placenta; Accidental Hemorrhage.

Hemorrhage may occur during labor or the later weeks of pregnancy, as the result of a premature, partial, or complete detachment of a normally inserted placenta. To this form of bleeding Rigby, as already explained, applied the term accidental hemorrhage.

Hemorrhage of this character is exceedingly rare, occurring once in 8000 or 10,000 cases. Goodell, in 1870, had collected but 106 cases.

Varieties. Two varieties of accidental hemorrhage are usually described: *apparent, and concealed or internal hemorrhage.* In the first variety the blood finds its way between the membranes and the decidua, and escapes through the cervix. In the second variety, the blood fails to find an outlet, and may collect in sufficient quantity within the uterus to occasion alarming symptoms or even death, with no visible bleeding. The former variety is the most frequently met.

In the concealed form, according to Goodell, either of the following conditions may obtain: 1. The placenta may be detached at the centre, the margin being still adherent. 2. The placenta may be detached at one edge, the membranes being separated for a short distance beyond the placental margin. 3. The edge of the placenta and the adjacent portion of the membranes being detached, the latter may rupture, permitting escape of blood into the amniotic sac. 4. Detachment of the placenta may take place, accompanied with separation of the adjacent membranes, but the fœtal head, acting as a ball valve, or a blood-clot in the cervix, may prevent external escape of the blood.

While the first attack of hemorrhage may occur after labor has commenced, almost invariably it takes place during the last three months of pregnancy.

Etiology. Probably the most common predisposing cause is to be found in a diseased condition of the decidua or in certain morbid states of the placenta itself. Tubercular and syphilitic degenerations of the lining of the uterus are recognized causes. Cases have been reported in which the placenta was found to be the seat of a beginning fatty and calcareous degeneration. Nephritis, extreme anemia, diabetes, and some of the acute infectious diseases, as scarlatina, diphtheria, and variola, have been assigned as etiological factors. Certain anomalies of the fœtal appendages, great distention of the uterus, and short cord may favor premature separation of the placenta; most cases occur in multiparæ who have borne many children or whose general health is impaired. In the presence of any of the foregoing predisposing causes, it is easy to understand how an apparently trivial exciting cause may give rise to slight separation of the placenta from its attachment to the uterine wall. Thus, trauma, as by a blow on the abdomen, a fall, violent muscular exertion, and emotional disturbances, etc., must be counted among the exciting causes of accidental hemorrhage.

Diagnosis. APPARENT VARIETY. The existence of hemorrhage is obvious. Rupture of the uterus and placenta prævia must be excluded. The former occurs later in the labor than does accidental hemorrhage, and is characterized by recession of the presenting part, diminution of the uterine tumor and the development of a new abdominal tumor; placenta prævia is readily differentiated by a physical examination. In accidental hemorrhage the uterine tumor is increased in size, and the flooding usually takes place before the rupture of the membranes.

CONCEALED VARIETY. First to attract attention usually are the systemic effects of hemorrhage. If the blood effusion is extensive, the fact is betrayed by pallor, anxious expression of countenance, cold extremities, feeble and rapid pulse, sighing respiration, collapse. The uterine contractions are weak, yet continuous uterine pain is sometimes present, owing to distention of the perimetrium.

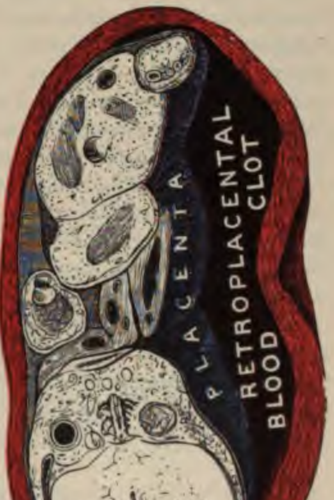
On abdominal examination, bulging of the uterine wall may be noted at the seat of the blood collection; the uterine tumor presents a boggy feel, the fœtal parts are indistinctly felt, and the fœtal heart-sounds are feeble and irregular. The condition may sometimes be detected by pushing up the presenting part and allowing a portion of the blood and liquor amnii to escape. It should not be forgotten that concealed may coexist with an insignificant external hemorrhage.

Concealed accidental hemorrhage might be confounded with ruptured tubal pregnancy, but the latter is readily distinguished by physical exploration and by its history.

Prognosis. In apparent hemorrhage the prognosis is good for the mother, but is frequently fatal for the child. In the concealed variety the prognosis is grave. The maternal mortality is more than 50 per cent., while about 90 per cent. of the infants are lost. The high death-rate in case of the mother is due to extreme anæmia, sepsis, post-partum hemorrhage, and to shock and exhaustion from overdistention of the uterus. The fœtal mortality arises chiefly from asphyxia, the result of interruption of the utero-placental circulation. Prematurity is sometimes a factor.

Treatment. In the external variety of hemorrhage, if the bleeding is moderate n amount, the mother's condition being fairly good, and the fœtus still viable, he only treatment demanded is rest in bed, a full dose of opium, and absolute quiet for a week or ten days. Even a moderately free hemorrhage may sometimes be arrested by these means.

FIG. 339.



Frozen section of the uterus of a woman who died of accidental hemorrhage at the Maternité de Beaujon. (PINARD and VARNIER.)

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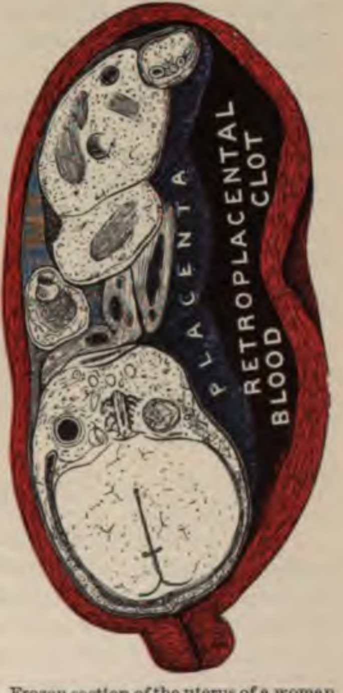

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In either variety, when the blood-loss is alarming, the uterus must be emptied. If the os is partially dilated, the membranes should at once be ruptured. If the os is small and rigid, the vaginal tampon, or, better, a Barnes cervical dilator may be employed. This temporarily arrests the bleeding and at the same time dilates the cervix. While the use of the vaginal or the cervical tampon is open to the objection that it may convert an external into a concealed hemorrhage, this is scarcely possible if the uterus is firmly supported with a tight abdominal bandage. After the membranes have ruptured the tampon is contraindicated. When immediate delivery is demanded the cervix may be incised.

If the condition of the mother permits, it is usually advisable to wait till the os is partially dilated before rupturing the membranes, as then version by Hicks's bipolar method may more easily be performed. Goodell, however, advises early rupture of the membranes, immediately followed by the application of a very tight abdominal binder over a pad placed above the fundus of the uterus, together with the free administration of ergot. Labor should be terminated as speedily as possible by manual dilatation and version, or forceps.

If the patient's condition is such as to forbid active obstetric interference, she should be stimulated freely, the foot of the bed should be elevated, and means taken to replace the blood lost by hemorrhage before subjecting her to the additional shock of version. The relaxed uterus should be made to contract by means of friction or compression of the fundus, a firm abdominal compress, and the administration of small doses of ergot.

If the child has perished, craniotomy is advisable if the os is not fully dilated. Cæsarean section, which has been advocated by certain authorities, can seldom be justified.

The after-treatment consists in measures intended to promote uterine contraction and in the treatment of acute anæmia. The woman is especially liable to post-partum hemorrhage. The treatment, both prophylactic and remedial, is the same as for post-partal hemorrhage under other conditions.

The shock and collapse of anæmia are to be combated with strychnine, alcoholic stimulants, and by submammary or intravenous injections of normal salt solution. Elevating the foot of the bed and autotransfusion, by bandaging the extremities, are useful expedients.

Post-partal Hemorrhage.

There is no emergency in obstetric practice that more seriously jeopardizes the patient's life, that calls for more prompt and energetic treatment, none in which the courage and skill of the obstetrician are more abruptly put to the test, than in severe post-partal hemorrhage. The obstetrician is usually dependent solely upon his own resources. There is no time for consultation; a few moments may turn the scale either for or against the patient's recovery. Fortunately for both patient and physician, this, as a rule, is a preventable accident.

Spiegelberg declares that grave post-partal hemorrhage is almost without exception the fault of the medical attendant. The fact cannot be too strongly impressed upon the student's mind, that with proper management of the third stage of labor post-partal hemorrhage is one of the rarest of accidents.

Etymologically, the term post-partal hemorrhage applies to a hemorrhage arising at any time after the birth of the child and from whatever cause. The term, however, in its technical sense, is restricted to hemorrhage from the uterine cavity occurring during the first few hours after the child is delivered; in the great majority of instances it takes place before or immediately after the placenta is expelled.

The term "secondary post-partal hemorrhage," or puerperal hemorrhage, is applied to flooding coming on after the first six hours of the puerperium.

Hemorrhage from rupture or inversion of the uterus, malignant or benign growths of that organ, or from lacerations of the cervix or vagina, are not included under post-partal hemorrhage in the technical sense of the term.

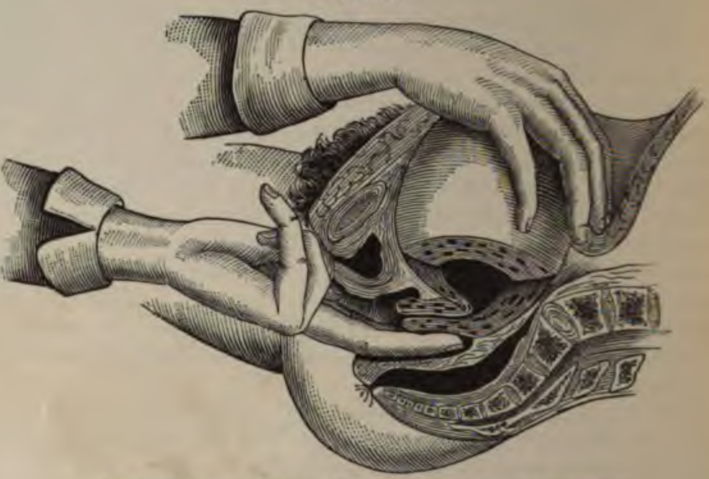
Frequency. The records of hospitals and large lying-in institutions, from which statistics are mainly gathered, and in which the labors are conducted presumably by men of special skill, naturally show a smaller frequency of cases of post-partal hemorrhage than is observed in private practice. Playfair considers post-partal hemorrhage of some degree one of the commonest complications with which the obstetrician has to deal. On the other hand, the records of Guy's Hospital furnish but 1 case of dangerous post-partal hemorrhage in 2040 labors; St. Thomas's Hospital reports give 1 in 2172 labors; Veit, from the statistics of a number of Continental authorities, was able to collect only 5 fatal cases in 47,765 deliveries. This latter statement certainly underestimates the death-rate from this cause. In general, it may be stated that mild post-partal hemorrhage occurs once in 100 labors; severe, once in from 1000 to 1200; and fatal hemorrhage once in from 4000 to 6000 labors.

Etiology. *First.* The principal cause of post-partal hemorrhage is uterine inertia or atony of the uterine muscle. Normally, with the separation of the placenta there is a certain amount of blood-loss, which, however, is quickly controlled by the firm contraction of the uterus; the uterine sinuses are closed by the contraction of the network of muscular fibres with which the bloodvessels of the uterus interlace. Hemorrhage of any considerable amount cannot take place from the cavity of a thoroughly and permanently contracted uterus.

There are numerous remote causes which contribute directly or indirectly to the occurrence of post-partal hemorrhage. Prominent among them is exhaustion following a prolonged and difficult labor.

After precipitate labor and sudden expulsion of the child, flooding may occur before time enough has elapsed for uterine retraction to take place. Overdistention of the uterus, as in hydramnios, multiple pregnancy, etc., frequently results in uterine inertia; a distended bladder or rectum tends to inhibit normal uterine contractions. The retention of secundines or of blood-clots may prevent full uterine retraction and the secure ligation of its vessels. New growths in the uterus may have a like effect. Profound anæsthesia continued for a long time tends to more or less complete atony of the uterus. Certain constitutional diseases predispose to this accident, as nephritis, extreme anæmia, and hæmophilia. Hemorof one hand well back into the posterior cul-de-sac of the vagina, while the external hand, grasping the fundus through the abdominal wall, makes counter-pressure. The uterus is thus strongly anteflexed. Sometimes, instead of this, the uterus may be crowded down with one or both hands on the abdomen and compressed against one iliac fossa.

FIG. 340.



Bimanual compression producing anteflexion. (SCHROEDER.)

Compression of the abdominal aorta as a temporary means of controlling this form of hemorrhage has long been practised. Its great virtue lies in the fact that it can easily and quickly be applied, and it often enables the physician to gain time for other procedures.

While the physician is thus engaged in seeking to stimulate uterine contraction, he may direct the nurse or assistant in the use of other measures. A full dose of ergot by the mouth, or better, hypodermically, because more quickly absorbed, should be given. In the presence of exhaustion, stimulation will be demanded: thirty drops to one drachm of sulphuric ether, one-fifteenth to one-twentieth grain of strychnine, or several drachms of brandy should be administered hypodermically. The child should at once be put to the breast, as nursing provokes uterine contractions.

Even in the time of Hippocrates we find mention of the employment of various irritating chemical solutions and mechanical substances in the cavity of the uterus for the purpose of exciting uterine contractions and the arrest of bleeding. The introduction of ice into the uterus, while not now used as much as formerly, may be permitted, in the absence of other measures. A lump of ice the size of an egg is carried to the fundus of the uterus, and held in position till contraction occurs. The application of acetic acid, lemon juice, or alcohol in the uterine cavity is a powerful excito-motor. Either of these agents may be utilized by saturating a piece of sterile gauze with it and passing the gauze into the uterus.

Penrose for many years advocated the employment of vinegar for the control of post-partal hemorrhage in the following manner: A clean piece of lint or gauze is saturated with vinegar, carried to the fundus of the uterus, and squeezed dry, the fluid running down over the walls of the uterus. A single application will often be followed by vigorous uterine contractions. If necessary, the process may be repeated two or three times. A lemon with the rind carefully pared off, and with numerous deep longitudinal slits to allow the escape of the juice, has been used in the same manner. A grave objection to these measures is the risk of infecting the uterus.

Barnes recommends in extreme cases intra-uterine injections of a solution of perchloride of iron. This procedure cannot be condemned too strongly. Not only is the woman exposed to the danger of pulmonary embolism, but a mealy mass of blood-clots is left in the uterus, which may serve as a nidus for the growth of putrefactive and pathogenic bacteria.

The intra-uterine injection of hot sterilized water has recently come to be regarded as one of the most reliable means for the control of post-partal hemorrhage. In many of the Continental hospitals, and very largely in America, this method has become the routine treatment for uterine hemorrhage. The external genitals should be well smeared with carbolized vaseline or olive oil, to relieve pain from contact of the hot water with the skin. After removing the placenta and all clots from the uterus and vagina, a long douche-tube, preferably of glass and with openings only at the extreme end, is carried to the fundus. Several gallons of water are injected at a temperature of 48° C. (120° F.), or as hot as can be borne. The temperature of the water should not exceed 125° F., lest the uterine muscle be paralyzed. Neither should it be below 115° F., as merely lukewarm water favors hemorrhage. The temperature should be determined accurately by a bath thermometer. Either a fountain or a Davidson syringe may be used, preferably the former.

If the hemorrhage is not checked by this means, the injection should at once be repeated, after adding to the sterilized water enough pure acetic acid to make a 3 per cent. solution, 4 fluidounces to the gallon. This is aseptic and is free from the dangers of vinegar or of the iron solutions. Its action is usually immediate and permanent.

Simple measures failing, the uterus should be tamponed with strips of aseptic gauze; this procedure, if properly carried out, will control a hemorrhage which resists all other measures. The method is as follows: Three strips of plain sterilized gauze are cut, each three inches wide and about ten feet in length. The patient lies on her back across the bed, each thigh being supported by an assistant, and a vaginal douche of sterilized water is first given. The uterus is then irrigated. Each lip of the cervix is seized with vulsellum forceps or a tenaculum and drawn down toward the vulva. An assistant holds the tenacula. The operator now makes pressure on the fundus of the uterus with one hand, while with the other he grasps one end of a strip of gauze in a long uterine dressing-forceps and carries it to the fundus of the uterus. Successive layers of gauze are now deposited one on the other with moderate firmness until the uterus is completely filled. The ends of the gauze may be left projecting into the vagina, in which a little gauze may be loosely placed. If strict antiseptic precautions have been observed, the tampon may safely be left in the uterus twenty-four hours. Renewal of the tampon is very seldom required. The efficacy of the uterine tamponade may still further be increased by saturating the gauze with a strong alum solution.

One of the most effectual measures for promoting energetic uterine contractions is faradization of the uterus. An electrode may be applied upon the abdomen over each side of the uterus or one upon the abdomen over the uterus, and the other over the upper sacral region.

Treatment of Acute Anæmia. The principal measures available for restoring the volume of the circulatory flow are transfusion, auto-transfusion, subcutaneous, submammary, and intravenous injections of the normal salt solution, and rectal injections of this solution.

Transfusion, or the introduction of blood from one person directly into the venous circulation of the patient, is a method formerly much in vogue, but now no longer practised.

Auto-transfusion consists in forcing the blood from the extremities into the trunk and brain, and retaining it there by bandaging the extremities. An Esmarch bandage may be applied to one arm, beginning at the fingers, and one to the opposite leg and thigh, beginning at the toes. Only two extremities should be constricted at once. These bandages may be left on twenty minutes to half an hour, and before their removal the opposite leg and arm should be bound in the same manner. By thus alternating the constriction, the danger of thrombosis and embolism is diminished.

The use of the normal saline solution, introduced into the circulation either subcutaneously, directly into the veins, or by high rectal enemata, is the means now most generally relied upon. The normal saline solution consists of a solution of sodium chloride of the strength of seven-tenths of 1 per cent. in sterilized water; before using, it should be raised to a temperature of 37.5° C. (98° to 100° F.), and filtered through absorbent cotton. This solution may be prepared with sufficient accuracy by adding a teaspoonful of salt to a quart of sterilized water. Subcutaneous injections may be made with Münchmeyer's apparatus, or in the absence of this by means of an aspirating needle attached to a rubber tube having a funnel, fountain syringe, or a rubber bag at the other end. From one to three pints of fluid may be used. These injections may be made beneath the skin of the abdomen, thigh, or back, or better, behind the mammary gland. High rectal enemata of the same solution may be given at frequent intervals and in as large quantities as can be retained. The patient should also be encouraged to drink freely of water, yet stomach absorption is usually in abeyance.

Intravenous injections of the normal salt solution are given in the following manner: A funnel holding a quart, to which is attached a rubber tube terminating in a fine pointed glass tip or a metal canula, is filled with the previously prepared salt solution, which must be absolutely sterile and free from mechanical particles. The temperature of the solution should be about 37.5° C. (100° F.). The integument over the median basilic vein is now carefully disinfected, and the vein made prominent by a snug bandage applied about the arm below the shoulder. An incision one inch in length is made parallel with and at one side of the median basilic vein. The vein is now freed from its attachment for a distance of half an inch with the handle of the scalpel. An aneurism needle threaded with a double silk ligature is introduced beneath the vein, the ligature cut, and the aneurism needle removed. One of the ligatures is drawn into the lower angle of the wound, the vessel ligated, and the ends of the ligature cut away. The constricting bandage above the field of operation may be removed. The second ligature is drawn upward toward the upper angle of the wound and one knot loosely taken. Having the canula or small glass tip now close at hand, with a gentle stream running, the vein is picked up with a pair of dissecting forceps, and an oblique upward slit made with the scissors, care being taken not to cut through the entire calibre of the vessel. The canula is quickly introduced into the vein, the water running gently all the while, and is retained in position by drawing snugly the single knot of the ligature. The amount of solution introduced will vary from one to three pints, dependent upon the condition of the patient. The height at which the glass funnel is held will determine the force of the stream; usually three feet above the patient's body will be sufficient. When enough fluid has been introduced, as indicated by the radial pulse, the canula should be withdrawn, the ligature quickly tightened, a second knot taken, and the ends of the ligature cut away. The vein between the ligatures should now be completely divided, the skin incision closed by two or three sutures, and a dressing applied.

Prolonged irrigation of the bowel with the hot saline solution at a temperature of 120° F. has recently been praised for the treatment of anæmia. A double-current canula is employed. As much as fifteen gallons of the salt solution may be used in this manner. Better results, it is claimed, are obtained than with subcutaneous injections.

Convalescence from the anæmia resulting from severe post-partal hemorrhage is slow and tedious. The patient should not be allowed to nurse her child nor to assume the upright position for some time. A light but nutritious diet should be ordered. Alcohol in the form of light wine or beer may be advisable. A patient who has suffered from post-partum hemorrhage should not be allowed to sit up for at least four weeks after her confinement. The employment of iron in some form, as a tonic and hæmatinic, is indicated.

Secondary Post-Partum Hemorrhage.

Hemorrhage from the uterine cavity occurring later than six hours after delivery is called secondary post-partum hemorrhage. Care must be taken not to mistake a profuse lochial discharge for true secondary hemorrhage. When in a given case bleeding occurs after the third day in any considerable quantity, a careful examination should at once be made, since the proper treatment to be adopted depends entirely upon an accurate determination of the cause of the hemorrhage.

The causes of secondary hemorrhage, arranged as nearly as possible in the order of their relative importance, are as follows: Retention of portions of placenta and membranes; clots in the uterine cavity; irregular and inefficient uterine contractions; displacements of the uterus; dislodgement of thrombi from the uterine sinuses; uterine fibromata and polypi; constitutional causes; overdistention of the bladder or rectum.

By far the most frequent cause of hemorrhage during the puerperal state is retention within the uterine cavity of fragments of the placenta or membranes. This retention may be due to the carelessness of the obstetrician, particularly in the conduct of the third stage of labor, or in the examination of the placenta. Often it is due to causes entirely beyond his control, such as adherent placenta, in which it is impossible to remove all placental tissue, or to placenta succenturiata or spuria. So commonly is secondary hemorrhage attributable to retained secundines that, in all cases in which profuse hemorrhage occurs after the third day following confinement, the obstetrician is justified in exploring the interior of the uterus at once, with full confidence that the cause of the hemorrhage will be found. To properly carry out the examination the patient should be anæsthetized. The cavity of the uterus may now be explored and fragments of placenta, membranes, or clots removed. The finger or, better, the blunt curette may be used. The interior of the uterus should be irrigated thoroughly with a hot weak antiseptic solution, as a 2 per cent. solution of creolin or a 5 per cent. solution of boric acid. If the hemorrhage persists, the curage or curettage must be repeated.

Clots in the uterine cavity may give rise to hemorrhage if they are of sufficient size to interfere with the firm contraction of that organ. Irregular and inefficient contraction of the uterus favors the formation of these clots; rarely does it become necessary to remove them. While their expulsion may be attended with a gush of blood, the bleeding ceases as soon as the uterus is empty.

Normally after labor the uterus is in a position of marked anteversion. It may, however, from various causes, become displaced backward or upward. The cause of this condition may be an improperly applied abdominal bandage or pad, or the undue pressure of a greatly distended rectum or bladder. The result of such displacements is flexion of the uterine canal, with consequent accumulation of blood and lochia above the seat of flexion. The bleeding from this cause is more apt to be a persistent oozing than a free hemorrhage. The treatment consists in removing the cause and in irrigating the uterine cavity with hot sterilized water.

Hemorrhage due to displacement of thrombi in the uterine sinuses may rarely occur. If, after exploring the cavity of the uterus for clots or retained secundines, nothing is found to account for the hemorrhage, the possibility of dislodgement of thrombi should be suspected, and the bleeding controlled by packing the uterus with strips of iodoform gauze.

Uterine fibromata and polypi may occasion secondary hemorrhage; their presence is recognized by a bimanual examination and by the sound passed into the uterus. The bleeding from a submucous fibroid can usually be controlled by small doses of ergot, opium, the local application of ice, or hot vaginal douches. The cause of the hemorrhage may be a small pedunculated polypus; such a growth may easily be removed by torsion or the wire écraseur. The full discussion of this subject belongs more properly to the gynecologist.

Malignant disease of the neck or body of the uterus may very rarely be the cause of hemorrhage in the puerperium. In such cases hot vaginal douches may suffice for the time.

It must not be forgotten that a puerperal hemorrhage may be due to inversion of the uterus.

Various constitutional conditions and diseases may favor hemorrhage during the puerperal state. Sudden and profound mental shock, a debilitated condition of the system, as that dependent upon advanced syphilitic or tubercular disease, some of the acute infectious diseases, as scarlatina, diphtheria, and malarial poisoning, and finally, the influence of causes inducing uterine congestion, such as sudden chilling of the surface of the body, too early assumption of the upright position after delivery, etc., sometimes give rise to uterine hemorrhage during convalescence from labor.

A distended bladder or rectum after labor is liable to be attended with uterine hemorrhage, since by its reflex effect it inhibits uterine contractions.

CHAPTER XXIII.

ECLAMPSIA.

Definition. By the terms eclampsia, puerperal eclampsia, and puerperal convulsions is meant, in modern medicine, an acute, morbid condition, making its advent during pregnancy, labor, or the puerperal state, which is characterized by a series of tonic and clonic convulsions, affecting first the voluntary and then the involuntary muscles, accompanied by complete loss of consciousness, and ending in coma or sleep. The disease may eventuate in death or recovery (Charpentier).

Frequency. Eclampsia is most frequent in the later months of pregnancy, less frequent in labor, and least frequent in the puerperium. Its occurrence is given by various authorities as 1 in 500 pregnancies; 1 in 250 to 300; 1 in 350 to 500—a range of 0.2 to 0.4 per cent. It is said that the complication appears in 1 per cent. of all cases of albuminuria of pregnancy. Schauta places it at 0.25 per cent. of all pregnancies.

Symptomatology. Symptoms of eclampsia may be classified as those of the prodromal period, or pre-eclamptic state, and those of the attack. In the latter, moreover, there are three stages: (1) invasion; (2) tonic and clonic convulsions; (3) coma.

PRODROMAL PERIOD, OR PRE-ECLAMPTIC STATE. These symptoms are of great importance, for to the experienced they are a certain sign of an impending attack. As in epilepsy, a well-defined aura may give the warning. Following it, or occurring without it, there may be headache, tinnitus aurium, visceral disturbances, such as dizziness, amblyopia, amaurosis, epigastric pain, digestive and nervous disturbances, and a feeling of general debility. These occur with a fair degree of constancy in about one-fourth of all cases of eclampsia. Less often symptoms of involvement of the brain occur, somnolence, stupor or insomnia, vertigo, vomiting, mental excitement, or despondency. All of them may subside, in which case appetite returns, perspiration and diuresis become more abundant, and the patient falls into refreshing sleep. Usually the issue is not so happy, and the premonitory signs, or pre-eclamptic state, after having existed for hours or days, give way to those of the

STAGE OF INVASION. The eyes stare, the lids twitch convulsively, and the pupils, at first contracted to a pin-point, dilate widely. During the attack they are totally insensible to light. The face becomes cyanotic, and the muscles about the alæ of the nose and the mouth jerk rapidly and convulsively. The mouth is drawn to one side, the head rotates, and the eyeballs are rolled up. This gives way to the

STAGE OF TONIC AND CLONIC CONVULSIONS. The movements, in the beginning confined to the head, extend to the neck, trunk, and extremities, rarely, however, passing to the legs. The neck is bent backward and fixed finally with the back in an opisthotonic curve. The arms are extended and rigid, the hands closed, with the thumbs in the palms, and the knees flexed on the abdomen. The tonic convulsions involve the respiratory muscles, including the diaphragm. During the height of the paroxysm there may be one or two spasmodic respirations, although the chest muscles are strongly contracted. The tongue is partially protruded, and, being often bitten, the frothy saliva is tinged with red. Loss of sensation and consciousness is complete. Tonic convulsions last from ten to twenty seconds, and are succeeded by clonic spasms.

As in the early part of the attack, the clonic convulsions begin in the face, which is horribly distorted, and extend over the body. Respiration becomes irregular and noisy. The jaws open and close rapidly, and the tongue may again be bitten. As a rule, the body retains its previous position, but it may become necessary to hold the patient in bed. Toward the close of the attack respiration becomes full, labored, and stertorous. After one or two minutes the patient passes into the

STAGE OF COMA. This period lasts about half an hour. During its continuance consciousness and sensation slowly return. If recovery is to take place, the woman falls into a deep sleep, and wakes to ask confusedly what has happened. This unconsciousness has led mothers to deny their offspring born during eclampsia.

It is an exceptional occurrence for one attack only to occur. The first is usually followed at varying intervals by others. In case the seizures are uncontrollable and death is to ensue, the temperature rises progressively to 104° F. or more. The pulse is small, wiry, frequent, a semiconscious state supervenes, and death takes place during this period or in an attack from pulmonary œdema, cerebral congestion, hemorrhage, or exhaustion, or some days later from an intercurrent puerperal affection.

THE EFFECT UPON THE FŒTUS AND LABOR is almost constant. The former suffers decidedly—one attack may be sufficient to kill it. In twin pregnancy one or both may die. The child may survive several attacks. Winckel has observed a remarkable fact, that, if the fœtus is killed and pregnancy not at once interrupted, the onset and course of labor may be free from convulsions.

Pregnancy is apt to be terminated shortly, an accident easily understood in view of the shock, nervous disturbance, and uterine contractions. If the seizure occurs in labor, the pains are increased by the general muscular excitement, so much so that the child may be born before the physician is freed from his care of the mother.

The kidneys are involved in about two-thirds of the cases of eclampsia. In 84 per cent. the urine contains albumin in quantity varying up to 2.5 per cent. or more. Albuminuria, an important prodrome, increases with each attack, and decreases rapidly after their cessation. It usually contains sugar and formed elements, red and white corpuscles, and casts. In other words, symptoms of acute renal congestion are present.

Etiology. The last word has by no means been spoken on this question, but this much may be stated with positiveness, that eclampsia does not always depend on albuminuria and kidney change, and, further, that albuminuria does not constantly accompany the convulsions. As may be supposed, many theories have been advanced to account for the phenomena, which, for a clear understanding of the subject, must be looked into and appreciated.

The theory of Frerichs, that eclampsia is uræmic, and that of Petroff and Spiegelberg, that it is due to ammonæmia, have been effectually disposed of by modern investigators, who have proved that there was absolutely no retention of nitrogenous products in the important organs. Moreover, on recovery the amount of these products excreted was not excessive—in fact, was only equal to the amount secreted in starvation. Traube, Mürck, and Rosenstein have held that hydræmia was the predisposing cause of eclampsia; but there stands in the way the fact that eclampsia has occurred where there was no hydræmia, and in cases of pregnancy where there were no contractions, the latter being the cornerstone of the theory, since it was held that the uterine contractions were responsible for increase of aortic pressure. Landois has claimed that hyperæmia, particularly a venous stasis in the brain between the corpora quadrigemina and spinal cord, is likely to produce epileptiform convulsions, while Galabin holds that eclampsia is due to anæmia of the cortical gray substance. Stumpf pins his faith to acetone as the exciting cause, since it has been found in the urine, and may be present in the exhalations. Its presence is not constant.

Fleischer and others were led to the belief that the cause of eclampsia was to be found in the *extractive materials* present in the urine, and that when they were retained in abnormal amount in the body, convulsions occurred, by the following facts: (1) The symptoms of eclampsia resemble those produced by poisonous material circulating in the blood; (2) in eclampsia the amount of urine excreted is diminished (whether due to compression of the ureters or not, we cannot say); (3) the danger lessens and the tendency to convulsion diminishes from the moment the amount of urine passed in twenty-four hours is markedly increased. This is the theory of *toxœmia*, which has been ably supported by Bouchard in his experiments upon animals. His statement is that eclampsia is an intoxication closely resembling uræmia (the latter word being used in its broadest sense), "to which, in unequal portions, *all* the poisons introduced normally into the organism, or found therein physiologically, contribute when the quantity of poison formed or introduced in twenty-four hours can no longer be eliminated in the same time by the kidneys, which have become scarcely sufficiently permeable." (The reader is referred for further elaboration of the theory to Bouchard's "Auto-intoxication," Chapter XV.).

Schmorl[1] ascribes eclampsia to an intoxication by coagulation, producing ferments, which ferments originate in the placenta.

Schmorl gives the following reasons for this conclusion:

1. The clogging of the vessels, reported by himself, Klebs, and Lubarsch, which is undoubtedly of primary origin, is like those thromboses which we observe in man and animals when coagulation-producing ferments are introduced into the blood.

2. Klebs' opinion that the coagulation-ferments are produced by the destruction of the embolic liver cells is wrong.

3. According to Schmorl's, Lubarsch's, and Jung's investigations, placenta-cells pass into the blood regularly, which cells, as experiments on animals show, have a tendency to provoke coagulation, at least when present in large number.

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[1] Path. Theses, Halle, 1892, vol. ii. p. 155.

Schmorl,[1] in another place, ascribes an important rôle to this thrombosis of the blood, stating that the thrombosis may be embolic in origin, but most often is primary.

In still another place[2] he states that the parenchymatous cells entering the circulation interfere with the chemical composition of the blood. . . . That in eclampsia coagulation of the blood occurs owing to parenchymatous embolism. He claims to be able to demonstrate in most cases of eclampsia the presence of thrombi in the arteries, and more especially in the veins. According to Schmorl's opinion, a toxic substance contained in the blood is responsible for eclampsia; experiment has shown that dying cells produce a ferment which coagulates blood, but he thinks that our knowledge about the metabolic process in the placenta is not enough to place the origin of this ferment in this organ.

Lubarsch[3] cannot accept Schmorl's opinion that the rôle of the liver cells in eclampsia is secondary. . . . From experiments and observations he believes that, owing to the penetration of liver cells into the blood current, a coagulation-producing ferment is produced. Lubarsch agrees with Schmorl that in some cases of eclampsia the thrombi are of primary origin, entirely independent of the liver cells. He nevertheless sees in the liver cells the factor for the production of coagulation and thrombosis with all its consequences. He believes the liver-cell embolism plays an important part in eclampsia, and that attacks due to liver-cell embolism will expose the organism to the formation of more thrombi and infarctions. He further believes that embolisms due to cells are not the cause of diseases combined with convulsions, but that they are the consequence of the convulsions.

According to Lubarsch[4] the liver-cell embolism is either of a traumatic nature or due to toxic infection, and appears to take place in all regions where, owing to the presence of necroses and hemorrhages of the liver, the tissues are subjected to increased pressure.

Volhard,[5] F., observed that the urine passed after an eclamptic attack was increased in toxicity, was imbued with specific properties, producing during life thrombosis when injected into the veins. This confirms Schmorl's statement that eclampsia is an auto-intoxication produced by a coagulation-producing poison. This substance, according to Volhard, does not injure the epithelium of the kidneys directly, but indirectly by clogging the nutritive vessels.

Ludwig and Savor[6] consider eclampsia as a process due to auto-intoxication by a ferment which is the product of metabolic processes, and masked in the organism during pregnancy, owing to the derangements in the metabolic processes. The action of the ferment is expressed by the symptoms of eclampsia. The removal of the ferment by the kidneys takes place after the convulsion. Whether this ferment is due to the lesions in the liver, or presents a connective link in the synthesis of urine, further investigation alone can determine.

[1] Path. anatomische Untersuchungen über puerperal Eclampsie Leipzig, 1893.

[2] Pathologische anatomische Befunde bei Eklampsie. Trans. of the German Gynecol. Soc., Leipzig, 1891, p. 179.

[3] Zur Lehre von der Parenchym. Embol. Fortsch. d. Med., 1893, vol. xi. p. 806.

[4] Die puerperal Eklampsie. Lubarsch u. Ostertag. 1898. vol. i. p. 120.

[5] Experimental und kritische Studien zur Pathogenese der Eklampsie. Monatsch. f. Geb. u. Gyn., 1897, Bd. v., H. v.

[6] Experiment. Studien zur Pathogenese der Eklampsie. Monatsch. f. Geburts. u. Gynaekol., 1895, Bd. i., H. v., p. 447.

This is where we stand to-day in regard to the etiology of eclampsia. As to the nature of the poisons, we are much in doubt, even if we accept all of Bouchard's statements. According to his experiments, urea contributes one-eighth of the total toxicity of eliminated urinary products, coloring matters, and other substances fixed by charcoal (leucin, tyrosin, etc.), two-fifths, the remainder being made up of mineral salts, chiefly of potassium. Since these statements are based on animal experimentation (other than human), they are to some extent unreliable. This short review of the theory of toxæmia explains the reason for the existence of many of the exciting and predisposing causes of eclampsia—*e. g.*, any interference with the permeability of the renal filter.

Predisposing Causes may be classed under three headings: (1) All chronic and acute forms of kidney disease, all nephritis, old and recent inflammatory changes, the recent "kidney" of pregnancy, which result in failure of elimination, hydræmia, albuminuria, and œdema. (2) Long-continued and marked retention of urine, particularly that produced by pressure on the ureters. This pressure may be exerted by (*a*) an abnormally enlarged uterus, as in twin pregnancy, hydramnios, etc.; (*b*) small pelves; (*c*) large fœtus or fœtal head. In proof of this cause stand the striking figures of the occurrence of eclampsia in 11 per cent. of multiple as against the 1.1 per cent. of single pregnancies. (3) Very young or very old primiparæ are particularly prone to attack on account of their rigid muscles and the lack of room in their pelvic and abdominal cavities. The proportion of eclamptic primiparæ to multiparæ is three to one (Schauta.)

Exciting Causes, acting in the presence of predisposition, may lie in (1) sudden, partial, or complete suppression of urine; (2) constipation; (3) painful uterine contractions, an unyielding external os or introitus vaginæ in primiparæ; (4) prolonged and exhausting efforts at expulsion; (5) profound emotion. The eclamptic convulsion once established, the slightest shock, external or internal, is sufficient to determine a paroxysm.

The Pathology of the condition is, as may readily be imagined, more than obscure. Post mortem the changes are an anæmia of the organs generally, a congestion of the cerebral cortex, occasional slight hepatic apoplexies, and a fluid condition of the blood. The chief changes, diminished urinary toxicity and corresponding increase in amounts of circulating poisons, are rather to be found *intra vitam* than after death.

Diagnosis of puerperal eclampsia, at first sight, appears to be simple, but to make a careless diagnosis is to invite a serious mistake sooner or later. The mere concurrence of a convulsive seizure with pregnancy or the puerperium does not *per se* warrant the conclusion that it is eclamptic. There are four conditions to which the pregnant parturient or the puerperal woman is subject which may be mistaken for eclampsia. They are (1) epilepsy, (2) hysteria, (3) apoplexy, and (4) meningitis.

Epilepsy is distinguished by the history of former and repeated attacks, by the presence of urine, normal in amount, free from albumin and casts (except in intercurrent nephritis), by coma more complete, by the absence of œdema and of prodromes, saving the usual aura. The epileptic falls suddenly with a sharp cry. *Hysterical* patients are conscious, as a rule, in the attack, the muscular contractions are less severe, there is never a coma. They scream, laugh, or cry, œdema is not present, and they pass large quantities of clear, pale urine. Here, also, a history of previous attacks may be elicited. *Apoplexy* is rare in pregnancy. It comes on suddenly without prodromata. Coma supervenes early. Convulsions are absent, and paralysis evident. *Meningitis* is even more rare. The history will aid materially in forming an opinion. The convulsions are local as opposed to general in eclampsia, and they increase in severity by easy stages. Fever always precedes their appearance.

In all cases of doubt careful attention should be paid to the urine, and its quantity, and the presence of albumin, sugar, blood, and casts thoroughly investigated. With these aids to the clinical picture, the attendant should have little difficulty in forming a correct opinion.

Prognosis. Puerperal eclampsia is a most serious affection. Even at the present day the maternal mortality is 30 per cent., that of the child 50 per cent. The pregnant woman who is suffering from decided symptoms of toxæmia, albuminuria, and the quantity of whose urine is daily diminishing, is in great danger of an attack. As the albumin increases and the quantity of water passed in the twenty-four hours diminishes, the danger becomes more imminent. The peril becomes more remote as the converse takes place. Urea, as to amount excreted, is a better guide in prognosis, as shown by Bouchard and Davis, than albumin. The latter found toxic symptoms to diminish with its increase. The earlier in pregnancy the seizure occurs the worse the prognosis. Schauta has proved time and again that all disturbances, even those of the kidneys, decline after the death of the child; consequently the sooner it dies in repeated attacks the better the prognosis. An early occurrence of profuse sweating is an encouraging sign. Prognosis is most unfavorable when the attacks occur in pregnancy, when they succeed each other rapidly, and become progressively more severe, and when they have lasted for some time before aid is secured. Chloroform treatment has lessened mortality in these cases. To sum up, prognosis is favorable when—

1. The attacks are infrequent and mild.
2. The child dies.
3. The patient is conscious in the intervals.
4. There is a small amount of albumin.
5. A fall of temperature occurs.
6. The attacks occur late in labor or during the puerperium.

Prognosis is unfavorable when opposite conditions prevail. The child born of an eclamptic mother has a diminished vitality, and often dies in the first twenty-four hours.

The *causes of death in the mother* are exhaustion, apoplexy from forcible rupture of the cerebral vessels, asphyxia due to spasm of the muscles of the glottis and of respiration, pulmonary and cerebral œdema, the result of serous effusion from distended capillaries, cerebral congestion, of which coma is a symptom, and paralysis of the heart. The last, when it occurs in the general spasm, causes instant death. The *causes of the child's death* are the mother's convulsions and the pressure exerted by them, asphyxia from compression or œdema of the placenta, or the excess of carbon dioxide in the blood, possibly direct poisoning by the toxic materials in the maternal circulation.

Treatment. Granted the contention, which, if not absolutely correct, is at least the best theory of etiology we have to-day, that eclampsia is the result of toxæmia, then of the two treatments of eclampsia, prophylactic and curative, the former is by all odds the more important, since the seizure is generally preventable. This is an opinion which is shared by many prominent American as well as foreign obstetricians.

(*a*) THE PREVENTIVE TREATMENT. What symptom or sign, or what combination of symptoms or signs, is at our disposal for the recognition of the pre-eclamptic state in time to prevent the subsequent eclamptic convulsions?

The symptoms of the state preceding an eclamptic attack include a rapid pulse, accompanied usually by high arterial tension, loss of appetite, gastric and intestinal disturbances, headache, lassitude mental and physical, a gradual or rapid diminution of all the excretions, both liquid and solid—in a word, what one would expect to observe from the introduction or retention in the blood of some toxic material.

Aside from the direct examination of the blood itself, the condition of the urinary secretion offers us the most convenient physical sign or clinical index of this pre-eclamptic state. The amount of urine passed in twenty-four hours is not always a reliable guide of kidney failure. Albuminuria, as is well known, may be absent before, during, and even after an eclamptic seizure. The amount of urea excreted is a far better guide, as has been shown by Bouchard, of Paris, in the non-pregnant condition, and recently by Dr. E. P. Davis, of Philadelphia, in pregnancy; for the latter found that when urea fell to 1.5 per cent. stimulation of the excreting processes resulted in distinctly favorable results in all cases in which toxic symptoms were previously present. It is not to be inferred from this that urea causes the convulsions, for large quantities of urea may be injected into rabbits without producing toxic symptoms. Indeed, Bouchard found that bile had nine times the toxic power of urea. It is generally accepted that the diminution in the amount of the urea excreted indicates kidney inadequacy; but it is not always a reliable guide. There are other substances in the urine with as great or greater poisonous qualities. Urea may be found in sufficient quantity and an eclamptic attack occur. Bouchard determined the toxicity of the urine by injections of the same into the circulation of rabbits. His experiments show that the normal healthy urine is toxic in the proportion of a certain unit per kilo by weight of the rabbit. In kidney insufficiency, when some poison or poisons are retained in the circulation, the toxic properties of the urine diminish, and it requires more of the urine to the kilo by weight of the rabbit to produce toxic symptoms in the animal. This gives us a delicate test for determining kidney inadequacy in doubtful cases. Bouchard's experiments further show that in renal insufficiency the poisons retained in the patient's blood arise from:

1. Food, especially nitrogenous food, as muscle, and food containing the salts of potassium.
2. Bile.
3. Putrefaction in the intestines, and absorption of its products.
4. Toxic materials constantly being produced by the metabolism of all the cells of the body.

To this last may be added the metabolism of the fœtal tissues, as this greatly increases the toxic material in the mother's blood, for, clinically, it is a familiar fact that when the fœtus dies *in utero*, or is delivered in the case of a living child, the eclamptic seizures usually cease.

Again, Winckel's observation, that in twin and triple pregnancies there is a greater predisposition to eclampsia, has been verified by others. Moreover, the tendency to eclampsia becomes greater proportionately with the advance of gestation and the consequent increase of fœtal metabolism.

Further, we know that the maternal mortality diminishes progressively from the ante-partum to the post-partum states, namely, that it is greatest when eclampsia sets in during pregnancy, is less during labor, and lowest of all when the attack occurs for the first time after the birth of the child. Thus, the mortality during eight years at the Boston Lying-in Hospital, as has been shown by Green,[1] was: ante-partum eclampsia, maternal mortality, 46 per cent.; fœtal mortality, 69 per cent. Intra-partum eclampsia, maternal mortality, 25 per cent.; fœtal mortality, 25 per cent. Post-partum eclampsia, maternal mortality, 7 per cent.

Our present knowledge of the causation of puerperal eclampsia, meagre though it be, furnishes us, if not with the key to the successful preventive treatment of the condition, still with a working hypothesis, namely, the early recognition of the pre-eclamptic state. To accomplish this something more than a perfunctory monthly or bimonthly examination of the urine for the presence of albumin is called for, since non-albuminuric eclampsia occurs in from 9 to 16 per cent. of cases, and it would appear to be quite as fatal as an eclampsia accompanied by albuminuria, if not more so. Something more is demanded than the late recognition of renal insufficiency, as it shows itself in a marked diminution in the quantity of urine, specific gravity of the same, and amount of urea excreted.

When obstetricians shall accustom themselves to watch their cases of pregnancy, not only for the physical signs of pronounced renal inadequacy as an index of an approaching eclamptic attack, but also for the general symptoms of the overcharging of the blood with toxic material —as high arterial tension, headache, gastric disturbances, physical and mental lassitude—and further for failure of the bowels, liver, skin, and lungs properly to perform their functions, and intelligently treat the same, then, and then only, shall they have done their whole duty by their patient, and done all in their power to correct the pre-eclamptic condition and avert an impending eclampsia.

The writer's line of treatment of this pre-eclamptic state may be formulated somewhat in the following manner:

1. *Reduce the amount of nitrogenous food to a minimum.*
2. *Limit the production and absorption of toxic materials in the intestines and tissues of the body, and assist in their elimination by improving the action of* (1) *the bowels*, (2) *the kidneys*, (3) *the liver*, (4) *the skin, and* (5) *the lungs.*
3. *If necessary, remove the source of the fœtal metabolism and of peripheral irritation in the uterus by the emptying of that organ.*

The first indication—reduction of the amount of nitrogenous food to a minimum—can best be fulfilled in an exclusive milk diet, to which, as the symptoms subside or disappear, can be added fish and white meats.

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[1] Green: "Puerperal Eclampsia: Experience of the Boston Lying-in Hospital in the Last Eight Years," American Journal of Obstetrics, 1893, xxviii. 18-44.

It is not only safer, but less trying to the patient, to commence with an absolute milk diet, than to compromise and afterward be compelled to cut off all but the milk. For the second indication—that of elimination—an abundant supply of pure air and water must be assured. This may be assisted by moderate exercise or light calisthenics, or massage, in certain instances. For the bowels, the writer advocates daily doses of colocynth and aloes at bedtime, followed by a saline in the morning. For the liver an occasional dose of calomel and soda at bedtime, followed in the morning by one of the stronger sulphur waters, as Rubinat, Villacabras, or Birmenstorf. Increased diuresis is secured by maximum doses of glonoin. The action of the skin is encouraged by encasing the body in wool or flannel underclothing, by massage, by the warm bath, hot bath, hot pack, or hot-air bath, according to the urgency of the case.

It is well in instances of eliminative insufficiency to give at bedtime twice weekly, or more frequently, if necessary, a tablet composed of calomel, digitalis, and squill, each one grain, and muriate of pilocarpine, one-twentieth of a grain. This is followed in the morning by a full dose of Villacabras water. A decided diaphoretic-diuretic action follows the administration of such a combination, with the additional prompt action upon the liver and intestines as well. So of the five eliminative processes, four are stimulated to more energetic action by its use.

The fact that jaborandi has been practically abandoned as a diaphoretic in the presence of an eclamptic attack is no good reason for prohibiting its use in this, the pre-eclamptic state, in the absence of pronounced cardiac disease, and the writer advocates its use for its diaphoretic and diuretic actions.

Finally, when exercise cannot be taken and an abundant supply of fresh air is wanting, oxygen inhalations will prove of service. Some preparation of iron will also be called for, as the tincture of the chloride, or Basham's mixture.

This, then, is the general hygienic and medicinal treatment of the pre-eclamptic state. No hard and fast rule can be laid down. Every case must be treated on its merits. In one a restricted diet and mild stimulation of the renal and intestinal functions is sufficient, and the patient may be allowed to be about, and even exercise in the open air, her skin being protected from sudden changes by being incased in wool or flannel. Other more pronounced cases of eliminative insufficiency must be kept absolutely quiet in bed upon an exclusive milk diet, and the stimulation of all the eliminative organs must be resorted to, to remove the symptoms of impending eclampsia.

But it must be kept ever before us that the hygienic and medicinal treatment is only of secondary importance to the milk diet, and that the latter is the foundation of the preventive treatment of puerperal eclampsia. Given a case in which, in spite of an exclusive milk diet and the vigorous stimulation of the five excretory outlets already mentioned, the symptoms and signs of the pre-eclamptic condition continue or at any time become urgent, the indication is to induce abortion or premature labor artificially.

It is difficult to undersand the position of those authorities (notably of the British school of midwifery) who advise against inducing labor in the presence of urgent symptoms of the pre-eclamptic state.

The arguments that by the methods usually in vogue induced labor increases reflex excitability and precipitates convulsions; that by the same methods, because of the time necessary to remove the barrier of the cervix, the patient's fate is sealed before the delivery is effected; and, moreover, that the onset of labor increases the danger to the patient, are good ones and demand attention.

In answer, it may be said that methods of terminating the pregnancy recommended here need not increase reflex excitability, and, if perchance they do, the excitability is readily controlled for the time necessary to accomplish our ends; that the time necessary is, in most cases, very short; and, finally, that to-day the onset of labor and the termination of pregnancy may be practically brought about at one and the same time, and there is thus no prolonged or tedious labor to react unfavorably upon the patient.

The objection raised by Byers (International Congress of Obstetrics and Gynecology, Geneva, September, 1896) that induced labor, because of the necessary manipulation, increases the risk of sepsis, should not deter the modern obstetrician from performing the operation when he knows that he is surgically clean.

Charles, of the Liége Maternity, reported, at the International Congress of Obstetrics and Gynecology in 1896, in favor of induced labor when treatment fails or the symptoms become urgent in the pre-eclamptic state. His statistical table shows that every mother recovered and 75 per cent. of the children were saved.

The writer recommends a rapid manual dilatation of the os in these cases, but only after the cervical canal is in a condition favorable for its safe performance. Moreover, he would insist upon a complete dilatation of the os before delivery is undertaken.

(*b*) THE CURATIVE TREATMENT. In the presence of an eclamptic attack we face a desperate condition. The latest statistics from various parts of the world still place the maternal mortality at from 25 to 35 per cent. As long as the pathology of eclampsia remains obscure there can be no rational curative treatment of the condition. Experience does not permit of recommending any single treatment. Many subjects recover, no matter what the treatment, many die in spite of treatment, and others do well without any treatment at all. No single treatment can be advocated; each case must be managed according to the indications present. Not a single but a combined treatment promises best for saving the lives of mother and child in the event of an eclamptic seizure. For this combined treatment three indications are offered, as follows:

1. *Control the convulsions.*
2. *Empty the uterus under deep anæsthesia by some method that is rapid and that will cause as little injury to the patient as possible.*
3. *Eliminate the poison or poisons which we presume cause the convulsions.*

Although these indications are named in the order of their importance, still they may all be carried out at the same time. In another class of cases we fulfil the first and third, and wait for a suitable moment to carry out the second. The third indication—elimination—should really go hand-in-hand with the first two and be put into action at one and the same time with them.

Control the convulsions. The four medicinal means most certain and safe as antieclamptics are chloroform, morphine (hypodermatically), veratrum viride, and chloral hydrate, the latter alone or combined with sodium bromide.

The writer's preference is for chloroform, veratrum viride, and chloral, in the order named. Until three years ago he used morphine freely in eclampsia, but has since abandoned its use almost entirely, as it apparently prolongs the post-eclamptic stupor and increases the tendency to death during coma by interfering with the eliminative processes.

Chloroform is of all agents the most reliable for immediate control of the convulsive seizures.

Second only to chloroform in value is veratrum viride. Provided the pulse be strong as well as rapid, it is the most certain means at our command for temporarily, and even permanently, controlling the convulsions. When the pulse is weak morphine hypodermatically, chloroform by inhalation, and chloral by rectum, with stimulation, if necessary, may be substituted.

Veratrum viride reduces the pulse-rate, and convulsions are practically unknown with a pulse-rate of 60 or under; it reduces the temperature; it relaxes and renders more yielding the rigidity of the cervical rings; it causes prompt diaphoresis and diuresis, so that it aids not only in the fulfilment of our first indication, the control of the convulsions, but in the third, the elimination of an unknown poison as well.

From ten to twenty minims of the fluid extract of veratrum viride, given subcutaneously, should, as a rule, be the initial dose. Ten minims more may be given in the same manner every half-hour till the pulse remains below sixty to the minute. The patient should be kept in a recumbent position while under the influence of the veratrum. Tumultuous action of the heart is likely to supervene on assuming the erect position. Vomiting and collapse, should they ensue, are readily controlled by whiskey or by morphine.

The last resort for controlling the convulsions is the prompt evacuation of the uterus. It may be added, however, that cold applications, such as ice-bags to the back of the head and neck, have a decided effect in controlling and in warding off convulsive attacks.

Empty the uterus under deep anæsthesia by some method that is rapid and that will cause as little injury to the woman as possible. Those who follow the teachings of Charpentier, of France, and Winckel, of Germany—namely, that the uterus in eclampsia should be left alone except after full dilatation of the os, as the irritation of inducing labor or artificially dilating a cervix precipitates convulsive attacks—will, doubtless, see many cases lost that could by prompt and intelligent measures be saved. It would appear from careful observation that the danger is practically over in some 90 per cent. of cases the moment the uterus is emptied, if accomplished early in the attack. Not that by this means the convulsions always cease, but they become less dangerous, and the case becomes one of post-partum eclampsia, in which the mortality, as we have stated, is only 7 per cent.

Although one can scarcely find an authority to-day who absolutely rejects local interference in the presence of ante-partum or intra-partum eclampsia, yet authorities differ widely as to the extent to which such interference shall be carried. Charpentier, in 1892, as the result of an exhaustive analysis of four hundred and fifty-four cases of eclampsia, and again in 1896, as the result of further observation, practically arrives at the same conclusion, namely:

1. That labor should be waited for and terminated naturally whenever possible.
2. That induced labor should be reserved for exceptional cases in which medical treatment has entirely failed.
3. That interference should be delayed until the cervix is dilated or dilatable, so as to avoid danger to the mother; that in eclampsia Cæsarean section, manual dilatation of the cervix, and especially deep incisions of the cervix are absolutely unjustifiable.

On the other hand, it would appear from the literature of the last five years, and from the reports of the International Congress at Geneva, September, 1896, that the weight of medical opinion is in favor of emptying the uterus in as short a time as possible in instances of eclampsia, whether the attack occurs before or during labor, although there is a wide range of opinion as to the means to be employed. In the second stage of labor, after dilatation has been secured, all authorities are agreed that the immediate emptying of the uterus is indicated and is to be performed promptly; the indication under such circumstances is readily carried out without additional danger to mother or child. In pregnancy and the first stage of labor the undilated cervix is the barrier to immediate delivery, and it is here that obstetricians differ so widely as to the best method of procedure. An expectant or palliative treatment means almost certain loss of the child, and something like one-third of the mothers are lost. On the other hand, the child is saved and the mother is practically safe, as far as the eclampsia is concerned, if the uterus is immediately emptied by appropriate surgical means.

During pregnancy and the early part of labor four procedures are offered for rapidly emptying the uterus, viz.:

1. Cæsarean section.
2. Mechanical dilatation of the cervix (various methods).
3. Deep incisions which at once completely remove the barrier of the cervix.
4. Combined mechanical dilatation and deep cervical incision.

The first method, Cæsarean section, for the relief of eclampsia still carries with it a high mortality (36.26 per cent., according to Charpentier's figures); moreover, there are many objections to its employment, as the uterine atony and hemorrhage, the irritation of the uterine and abdominal scars and of the curative peritonitis about the uterine sutures, all of which are to be avoided as exciting causes of subsequent eclamptic seizures.

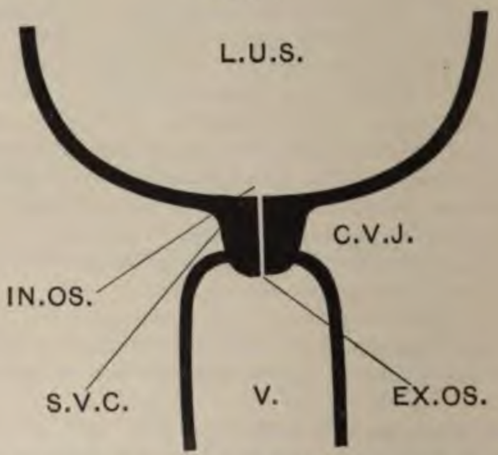
The second method, the mechanical dilatation of the cervix and the immediate extraction of the fœtus, appears to be the popular method of the day. Properly performed the method is safe and efficient. Before dilatation is well advanced, however, from forty minutes to an hour and a half is necessary safely to carry it out, and certain conditions of the cervix, even in this time, refuse to yield to manual dilatation or result in lacerations into the lower uterine segment.

The third method of delivery, by deep cervical incision, offers a surgical means for emptying the uterus in from five to ten minutes, provided the supravaginal portion of the cervix has disappeared or is made to disappear by appropriate means.

The fourth or combined method is a combination of the second and third methods, and is applicable to cases in which the supravaginal portion of the cervix is still present and rapid emptying of the uterus is demanded. Here mechanical dilatation of the os until the internal os has been caused to disappear is made use of, and the dilatation then in an instant completed by the incisions.

The third method and its modification, the fourth, are comparatively new, and we have few statistics as to the results of the operation. A rapid manual dilatation of the os and subsequent extraction of the fœtus will fulfil the indications in most cases; but unless this can be intelligently carried out, with a due appreciation of the mechanism of dilatation, especially in primiparæ, a purely expectant treatment will give better results. Unfortunately, puerperal eclampsia is four times more frequent in primiparæ than in multiparæ, although, on the other hand, the mortality is greater in the latter.

FIG. 341.

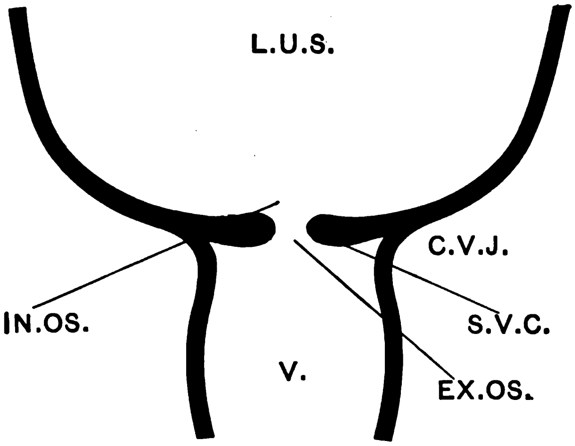


Cervix in latter part of gestation or at beginning of labor. Vaginal and supravaginal portions of cervix unchanged. (From EDGAR.)

V. Cuff of vagina. EX. OS. External os and infravaginal portion of the cervix. C.V.J. Cervico-vaginal junction. S.V.C. Supravaginal portion of cervix. IN. OS. Internal os. L. U. S. Lower uterine segment.

The cervix uteri is composed of constricting and dilating muscle, and, while it is true that the first convulsions usually induce labor, still the resulting asphyxia exerts a marked constricting action upon the body of the uterus and cervix, which is especially marked at the internal ring of the os. Therefore, any method of rapid manual dilatation of the os that is undertaken before the internal os has been made, partially at least, to disappear is attended with great danger of uterine rupture (Figs. 341, 342). This is especially true in primiparæ, in whom the supravaginal portion of the cervix obtains late in pregnancy and even up to the beginning of labor (Fig. 341). We believe a warning should be sounded against the careless undertaking of rapid manual dilatations of the os, particularly in eclampsia. Uterine rupture and death have been the outcome. Moreover, undue shock has resulted from the dragging of a fœtus through an imperfectly dilated os, to say nothing of the loss of the child.

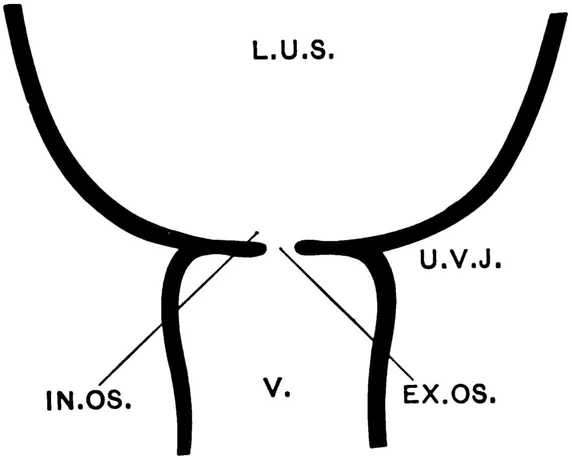
Fig. 342.



Lower uterine segment during labor. (From Edgar.)

v. Cuff of vagina. ex. os. External os, infravaginal portion of cervix has disappeared. c. v. j. Cervico-vaginal junction. s. v. c. Supravaginal cervix, small portion only remaining. in. os. Internal os. l. u. s. Lower uterine segment.

Fig. 343.

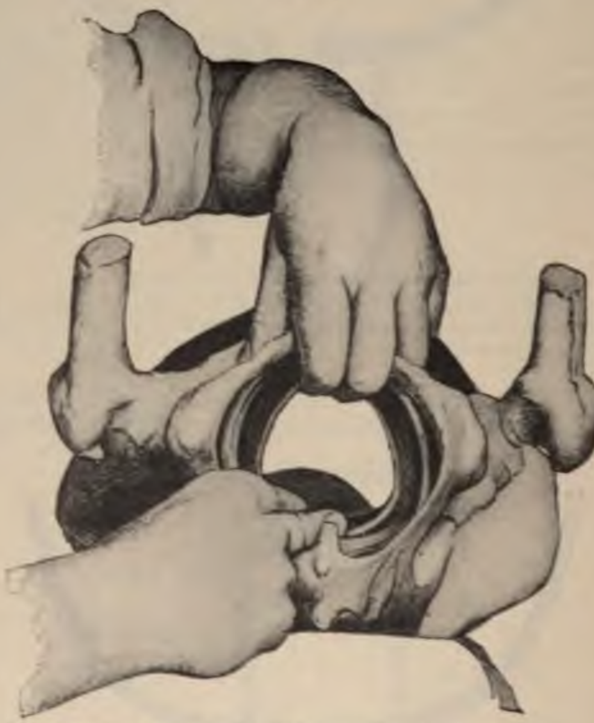


Lower uterine segment during labor. Os uteri in progress of dilatation. Supravaginal and infravaginal portions of the cervix have disappeared. Os admits one finger. (From Edgar.)

v. Cuff of vagina. ex. os. External os. in. os. Internal os. u. v. j. Utero-vaginal junction. l. u. s. Lower uterine segment.

In placenta prævia the hemorrhage and the resulting anæmia of the lower uterine segment and cervix render these parts more readily dilatable. In eclampsia the reverse obtains, as has been already hinted. Hence it is that in eclampsia in instances in which the internal ring of the os has been drawn up into the body of the uterus (Figs. 342, 343), and the external ring remains rigid and tense, particularly in primiparæ, and there is urgent need of rapidly terminating the labor, we prefer four clean incisions extending from the edge of the os to the utero-vaginal junction, in order to save the patient from the greater dangers of rapid manual dilatation.

FIG. 344.



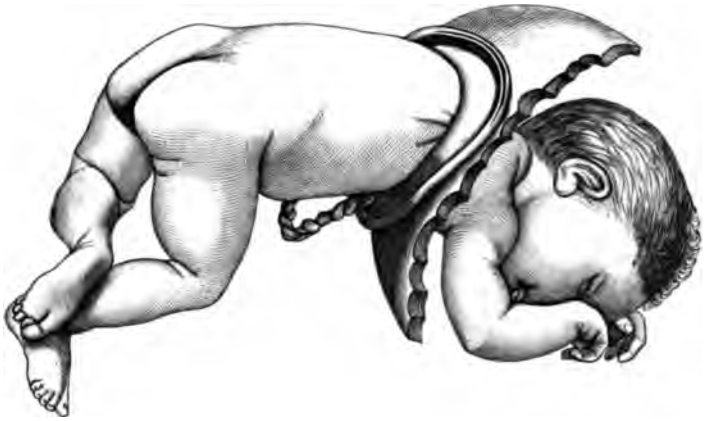
Bimanual dilatation of the parturient os. (From EDGAR.)
Os two-thirds dilated. Entire effacement of the internal os. Compare Fig. 343.

In the second place, a warning is not out of place against the premature extraction of the fœtus before full dilatation has been secured and the external ring of the os paralyzed. Premature extraction, under such circumstances, has, to the writer's knowledge, resulted in many unnecessary and dangerous lacerations of the lower uterine segment and an increase of the mortality for the child and mother.

Elimination of the poison or poisons which are presumed to cause the convulsions. To eliminate toxic materials from the blood and tissues the following measures may be relied on. It is essential, however, to rely not upon one but [illegible] the eliminative organs of the body, and that the fulfilment [illegible] third indication in the treatment of eclampsia should go [illegible] two already mentioned.

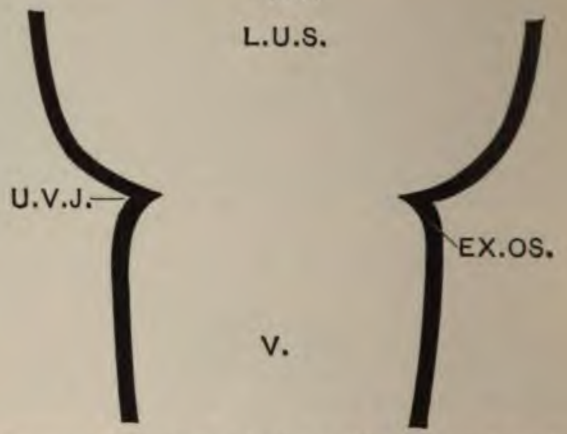
To this end catharsis must be secured as early and as promptly as possible by the administration of croton oil, compound jalap powder, or calomel, followed by salines and high enemata of sulphate of magnesium. In the coma or post-eclamptic stupor of the condition the writer has relied mainly upon the repeated administration of concentrated solutions of sulphate of magnesium or Villacabras water, by means of a long rectal tube high up in the descending colon. The hypodermatic administration of magnesium sulphate has been found too slow and uncertain to be of any use. Diuresis is obtained by dry or wet cups over the kidneys, followed by hot fomentations. The value of glonoin as a diuretic and antieclamptic, the latter by reducing the arterial tension, cannot be overestimated. Second only in value to glonoin is veratrum viride. It is to be given at this time for the same reasons and for the same results as when it was administered in the pre-eclamptic condition. Diaphoresis is encouraged by means of the hot-air bath or the hot pack, the writer's preference being for the former. Pilocarpine as a diaphoretic in the presence of an eclamptic attack should be utterly rejected, because of the danger of œdema of the lungs and glottis which it may produce. These conditions may follow promptly upon its administration. The drawing off of large quantities of toxic liquids in the form of blood or serum, by means of venesection, catharsis, diaphoresis, diuresis, followed by the replacement of the same by intravenous, stomachic, rectal, or hypodermatic means, causing a washing or disintoxication of the blood and tissues, as it were, has thus far proved of doubtful value. On the other hand, the prolonged irrigation of the lower bowel with either normal saline or sterile water, by means of a long single or return-flow tube, has given most excellent results. In instances of collapse, with the small compressible pulse, the introduction into the blood of a normal saline solution is of the same value here as in collapse under other circumstances. As a diuretic the frequent (hourly) subcutaneous injection of ether has been highly praised by some. As a general stimulant, to assist in the elimi-

FIG. 345.



Dangers of a rapid breech extraction through an imperfectly dilated os. External os not fully dilated or paralyzed. Traction on the legs results in extension of the head and both arms. (From EDGAR.)

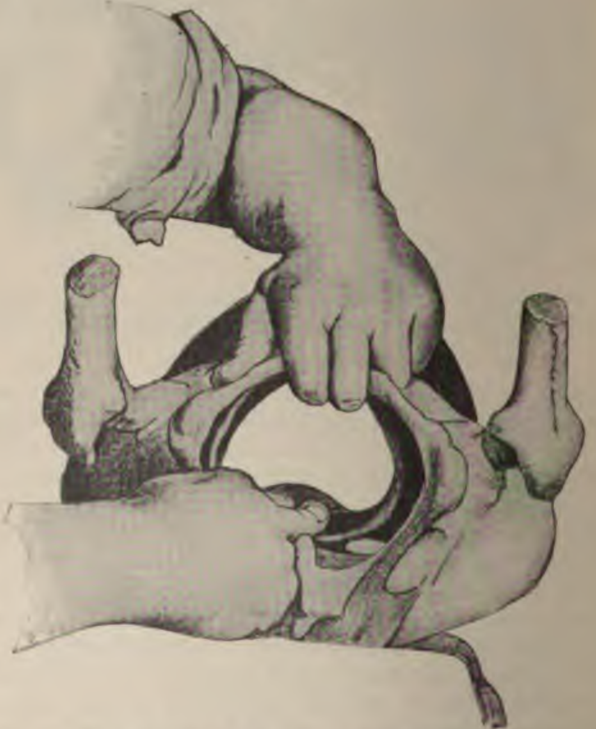
FIG. 346.



Lower uterine segment at completion of first stage of labor. Os uteri completely dilated. (From EDGAR.)

V. Cuff of vagina. EX. SO. Border of external os, scarcely perceptible. U. V. J. Utero-vaginal junction. L. U. S. Lower uterine segment.

FIG. 347.

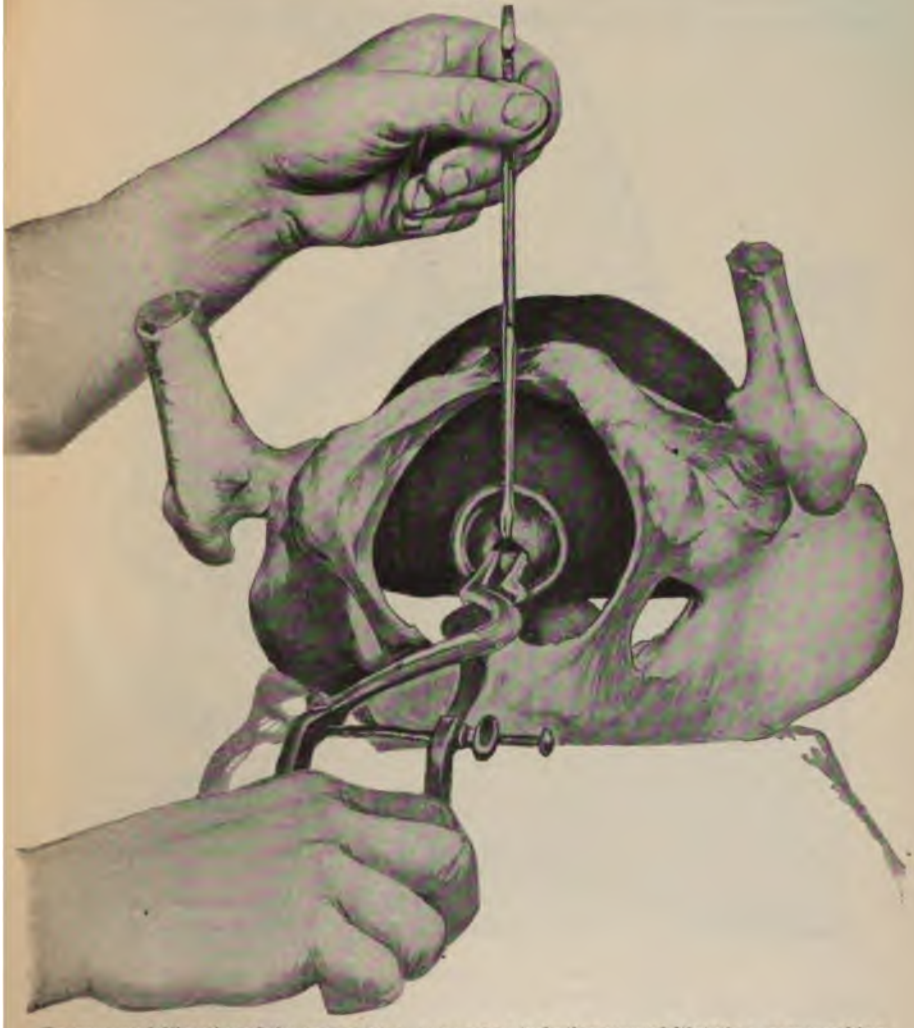


Bimanual dilatation of the parturient os. (From EDGAR.)

Os is fully dilated and is being stretched and paralyzed, to prevent subsequent accidents to the after-coming head during the extraction of the fœtus. Compare Fig. 341.

nation from the lungs and to prolong life in the post-eclamptic stupor or coma, the free administration of oxygen is of the greatest value. Further, alcohol will often be needed as a stimulant during and after an eclamptic attack, and strychnine in the post-partum state and in the face of threatened collapse—although for physiological reasons it would seem to be contraindicated—has served us well.

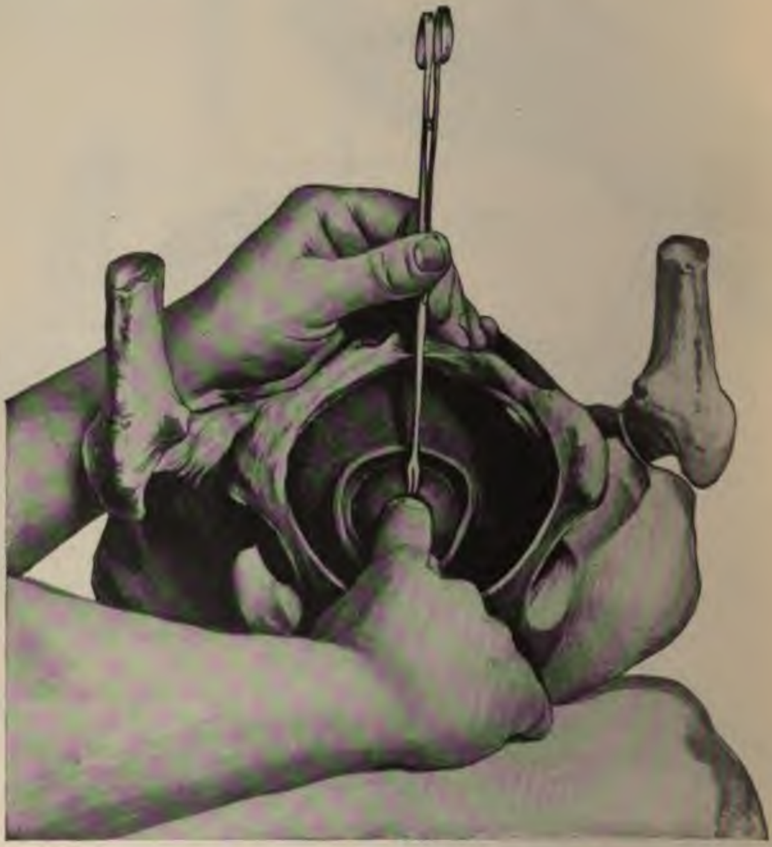
FIG. 348.



Instrumental dilatation of the parturient os, preparatory to further manual dilatation, gauze packing, and the introduction of bougies or cervical dilators for the induction of labor. (From EDGAR.)

Finally, although no one has been or is a firmer believer than the writer in the efficacy of a prompt removal of fœtal metabolism and of irritation for not only the control but the cure of the eclamptic condition, still he begs to enter a protest, first, against the careless use of the term *accouchement forcé* as applied to the rapid, scientific, and intelligent emptying of the uterus; and, secondly, to the easy confidence with which this *accouchement forcé* has been recommended as the best, if not the only, means at our command for the control of eclamptic seizures, without attaching sufficient importance to the condition of the cervical barrier. By *accouchement forcé* are understood to-day three operations, namely, (1) the complete instrumental or manual dilatation of the cervical canal, followed by (2) either combined or direct version, or the application of the forceps, and (3) the immediate extraction of the child.

FIG. 349.



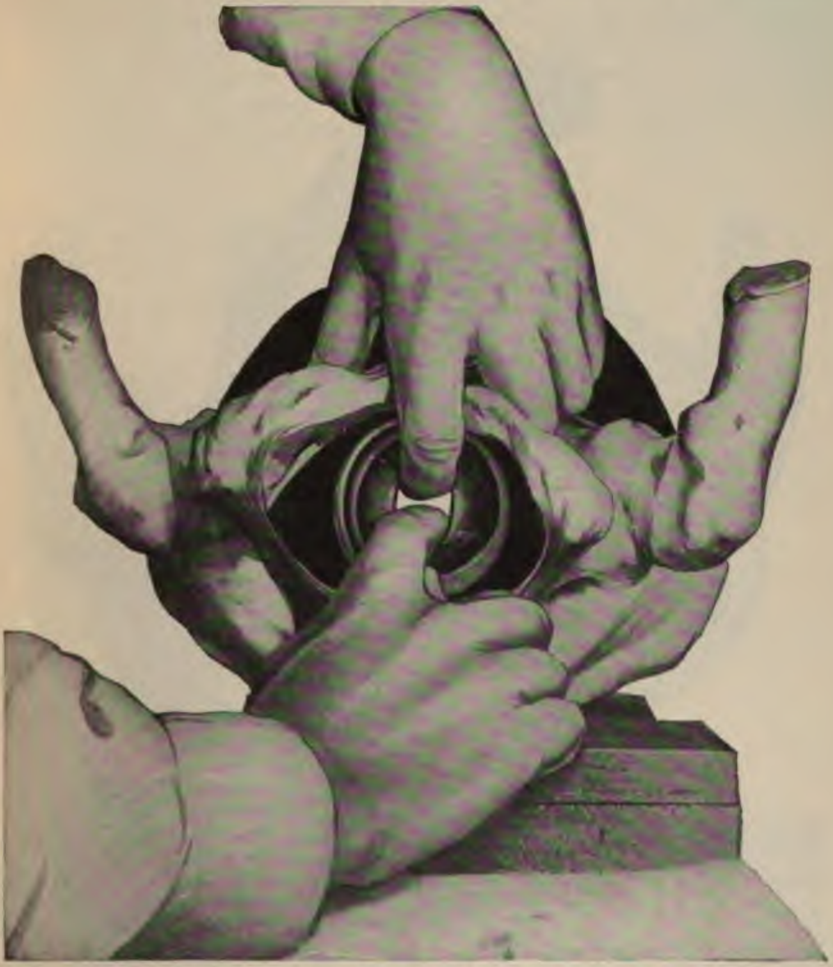
Digital dilatation of the parturient os. (From EDGAR.)

Os admits one finger. Vaginal and supravaginal portions of the cervix present. Compare Fig. 341.

The *accouchement forcé* of the older writers upon obstetrics was often quite another and more serious operation, for the condition of the cervical canal was frequently lost sight of, and it too often meant (1) the plunging of the hand or the application of the forceps through a cervical canal imperfectly dilated, and (2) the immediate extraction of the fœtus through this constricted os. That the latter definition of the term still obtains seems proven by the frequency of accidents in the extraction of the fœtus that are constantly being brought to light.

Our maternity hospitals are repeatedly in receipt of ambulance or emergency cases due to the neglect on the part of the operator to fulfil the first condition of the operation, namely, complete dilatation. It is no uncommon event for emergency cases to be brought to our hospitals with a podalic version or extraction partially completed because of the operation being attempted in the presence of a partially dilated os (Figs. 344, 345); moreover, for uterine rupture to occur, due to the same cause.

FIG. 350.

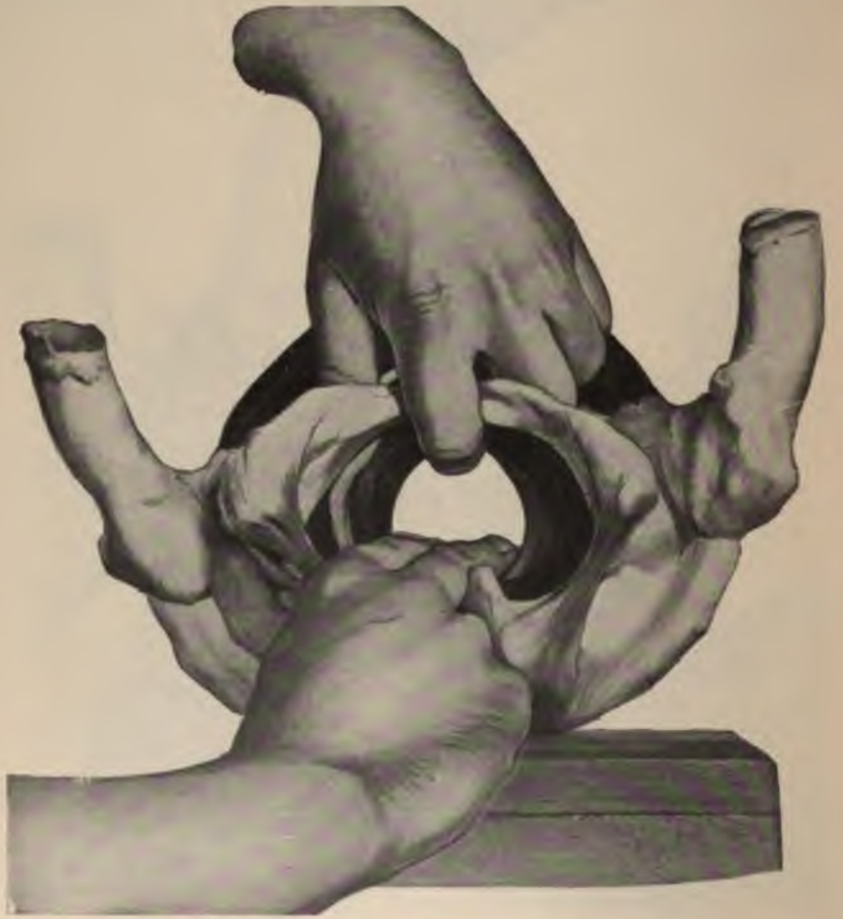


Bimanual dilatation of the parturient os. (From EDGAR.)

Os admits two fingers. Vaginal and supravaginal portions of the cervix present. Commencing shortening of the cervical canal. Compare Fig. 341.

In Fig. 345 is represented the outcome of a premature extraction through an imperfectly dilated os. With such a complication—a rigid, imperfectly dilated external os, grasping the fœtus tightly under the armpits—the loosening of the arms, the dragging of these, and subsequently the head through the os will take considerable time, and not only forfeit the child's life but subject the lower uterine segment to dangerous, if not fatal, rupture. Our plea in these cases is not alone for complete dilatation or disappearance of the external ring, as seen in Fig. 346, but further, for a paralysis of the ring, as we see it performed in Fig. 347, so that the dangers of the extraction, whether by forceps or version, may be reduced to a minimum for both mother and child.

FIG. 351.

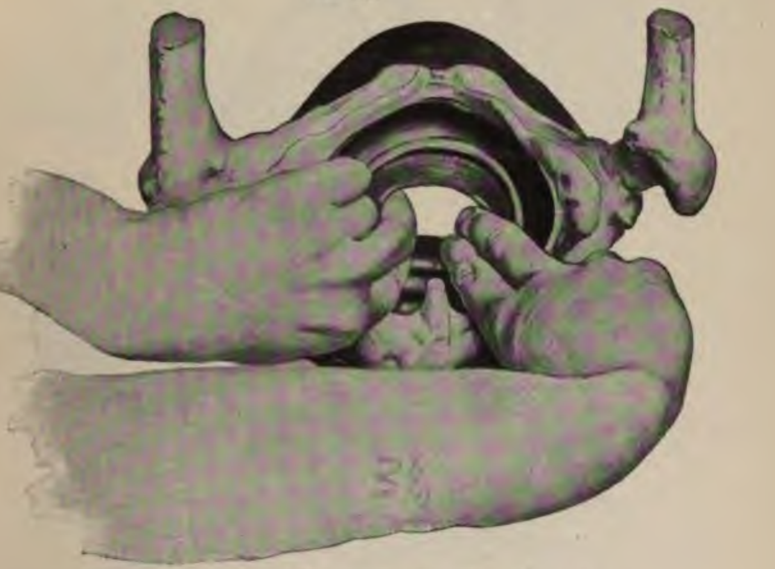


Bimanual dilatation of the parturient os. (From EDGAR.)
Os admits three fingers. Supravaginal portion of the cervix disappearing.

The limits of the present article forbid entering upon the arguments for or against any particular variety of rapid manual or instrumental dilatation of the parturient os, further than to state that the writer's preference is for a rapid bimanual method, as shown in the illustrations, since he has given this method an abundant trial over a period of several years, and it has proved most satisfactory.

The bimanual method is to be preferred to other digital and instrumental methods, because (1) the membranes are preserved throughout the operation or until full dilatation is obtained; (2) there is no interference with the original presentation and position; (3) the sense of touch of the operator's fingers is unimpaired; (4) there is no constriction of the operator's hands; (5) the amount of force exerted upon the external ring can be better estimated, and hence there is less likelihood of lacerations occurring; (6) in placenta prævia there is less preliminary separation of the placenta by this method than by any other; (7) by no other method with which we are acquainted can not only complete dilatation, but also complete paralysis of the parturient os, be so quickly and safely obtained (Figs. 344, 347).

FIG 352.

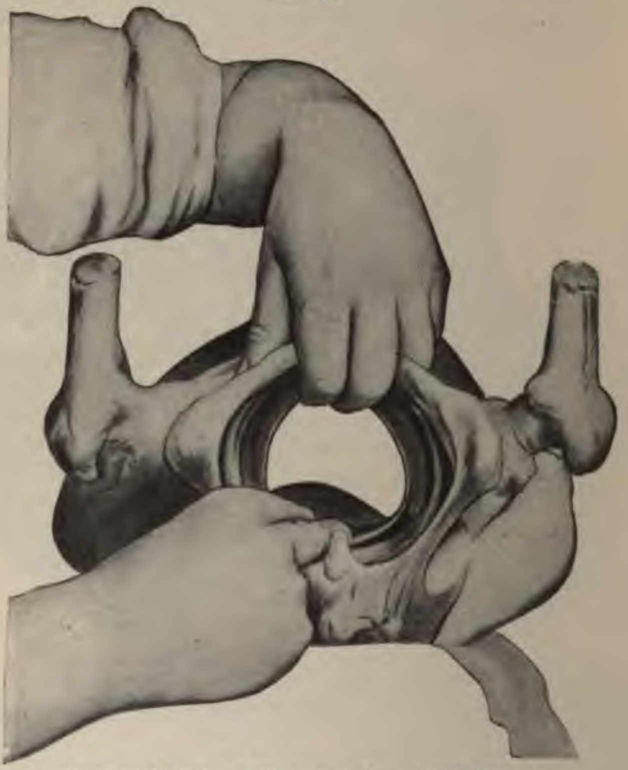


Bimanual dilatation of the parturient os. (From EDGAR.)
Os one-half dilated. Lateral position of the hands.

Again, the writer begs leave to protest against the undertaking of a rapid manual dilatation of the os (namely, the entire dilatation completed within an hour) before the cervix has become, at least slightly, relaxed by uterine action, and is already somewhat yielding. A rigid cervix, in the condition seen in Fig. 341, should receive preliminary treatment, by means of a cervical dilator of gauze or a hydrostatic bag, that will set up some uterine action and render the rings of the os yielding enough to make rapid dilatation a safe operation. In the presence of even a minimum amount of uterine action, or with a softening, yielding, and relaxing os, although the anatomical conditions shown by Fig. 341

may obtain, one may still undertake rapid manual dilatation and produce complete paralysis of the cervix within an hour, as seen in Fig. 347. Far better a purely expectant treatment, as regards emptying the uterus, than the attempt rapidly to overcome a rigid os by manual methods, the supravaginal portion of the cervix being present. The writer has known complete uterine rupture to result from such an undertaking, the maternal intestines prolapsing between the fingers of the operator. Fortunately for the eclamptic woman, the frequency of the attack increases proportionately with the progress of gestation, and, it may be added, with the increase of fœtal metabolsim. Hence, the attack is more frequent in the latter part of pregnancy and in labor, when we can more readily and safely apply our surgical principle of treatment, namely, an early and rapid evacuation of the uterus.

FIG. 353.

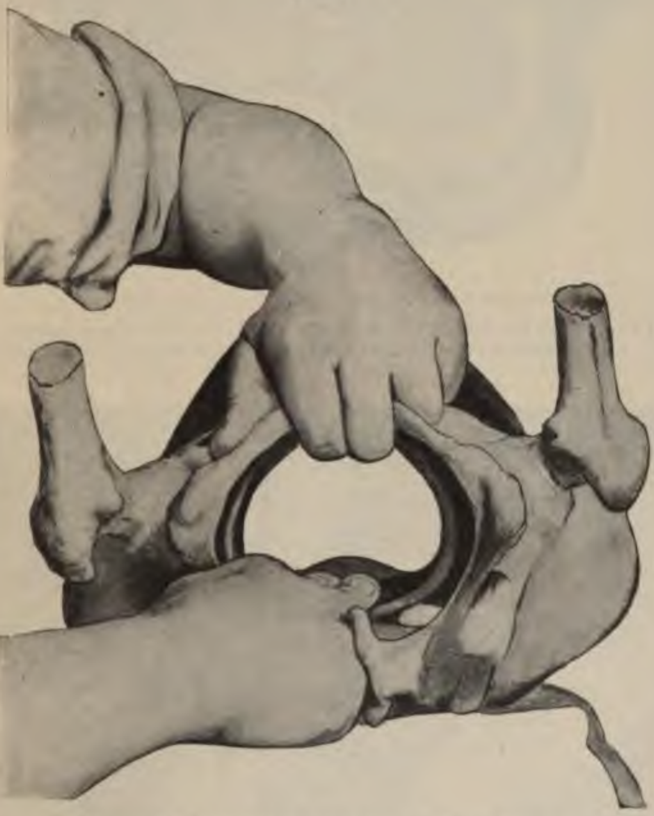


Bimanual dilatation of the parturient os. (From EDGAR.)
Os two-thirds dilated. Entire effacement of the internal os. Compare Fig. 343.

Unfortunately, the attack is four times more frequent in primiparæ than in multiparæ, and in the former the presence of the supravaginal portion of the cervix late in pregnancy, and of an unyielding and unrelaxed os, compels us to make use of preliminary and temporizing means before we can safely perform a rapid dilatation of the os and subsequent extraction of the fœtus. It is in such cases, and at such a critical time, one is waiting for the measures preparatory to a rapid dilatation mptying of the uterus to act, and to give us at least a yielding and ed cervical canal, if not a partial disappearance of the internal os, he writer has found veratrum viride most valuable and life-saving, ason of the various actions of the drug already mentioned.

order to render the preferred method of rapid dilatation of the ant or parturient os more graphic, and also that the sequence of the

FIG. 354.



Bimanual dilatation of the parturient os. (From EDGAR.)

lly dilated and is being stretched and paralyzed to prevent subsequent accidents to the after-coming head during the extraction of the fœtus. Compare Fig. 346.

ent steps of the operation may more clearly be set forth than they the limited number of illustrations in the article upon puerperal psia, the nine illustrations[1] (Figs. 348 to 356) are introduced.

e illustrations demonstrate the different steps in a rapid dilatation e os uteri, commencing with instrumental dilatation (Fig. 348), at

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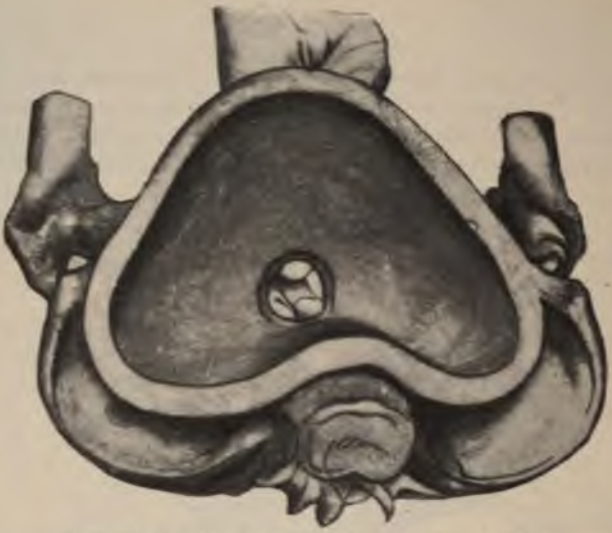
se illustrations are from photographs of composition and plaster models, and have already d in a series of articles on "Methods and Aids in Obstetric Teaching," published in the New edical Journal, November 14, 21, 28, and December 5, 1896.

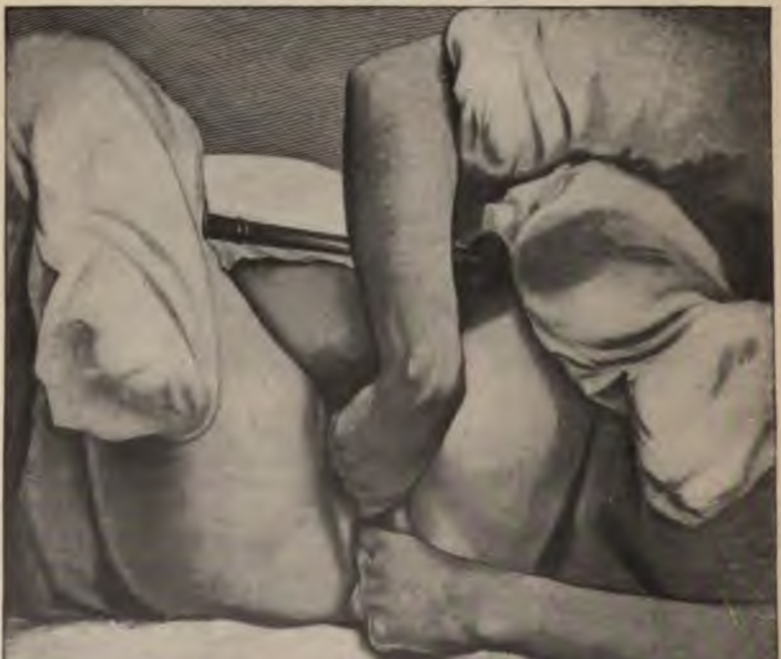
FIG. 355.



Bimanual dilatation of the parturient os. (From EDGAR.)

Internal view, showing the position of the fingers. Os admits three fingers readily. Internal os still present. No encroachment of the fingers upon the cavity of the lower uterine segment. Compare Fig. 356.

FIG. 356.



Bimanual dilatation of the parturient os. (From EDGAR.)

External view, after a photograph of the operation as performed at the Emergency Hospital, New York.

a time when the internal os has partially disappeared, and the cervical canal is somewhat relaxed and yielding, continuing with digital dilatation, and finally ending with bimanual stretching and paralyzing of the fully dilated parturient os uteri (Fig. 354). In Fig. 355 is shown the position of the fingers in the bimanual method of cervical dilatation, as seen from the uterine cavity; and Fig. 356 is added, which is after an actual photograph of the operation of manual dilatation of the parturient os, taken from nature at the Emergency Hospital (Bellevue Hospital service), in order that the position of the patient and the position of the operator's hands during the operation may be clearly seen.

CHAPTER XXIV.

DIABETES.—CARDIAC DISEASE.

DIABETES mellitus is a dangerous complication of labor and the puerperal state, as it is well known to be of surgical operations. Fortunately, it is rarely met with in obstetric practice. The disease may antedate the pregnancy or may develop in the course of it. That it may occur as a result of pregnancy would seem possible from the fact that in exceptional instances the disorder appears only during gestation, subsiding after delivery. It may be present in one or more and absent in subsequent pregnancies. A transient glycosuria is met with in a small percentage of pregnant women, but is most frequently a lactosuria. Lanz administered chemically pure grape-sugar to several women immediately after labor in quantities of 100 grammes to each. The urine was drawn by catheter just before the ingestion of the sugar and at the end of two, four, and six hours subsequently. In 30 per cent. of the urines grape-sugar was found. These observations go to prove that sugar metabolism is diminished in the first few hours or days of the puerperium and probably in the later weeks of pregnancy.

Frequency. There are no sufficient data on which to base a definite statement of the frequency of diabetes as a complication of labor. Statistics show, however, that the disease is associated with pregnancy in less than 1 per cent. of diabetic women. Women suffering from diabetes are usually sterile.

Diagnosis. The essential phenomena of the disease are the same in pregnancy as in other patients. The diagnostic evidence is to be sought chiefly in the urine. The test for sugar should be included in the usual urinary examinations during pregnancy, yet lactosuria must not be mistaken as evidence of diabetes. Lactose is sometimes present in the urine during the later weeks of gestation in healthy women. The liquor amnii is usually excessive in amount, and it contains sugar and sometimes acetone.

Prognosis. Pregnancy in women previously diabetic terminates in abortion in about 33 per cent. of cases. The prognosis for the mother is especially grave when the disease is aggravated by pregnancy and resists treatment. [illegible] danger to life is greatest in the later months. Fifty per cent. of [illegible] mothers suffering from this disease die soon after labor. Of 22 [illegible] Duncan, 4 were fatal after delivery, within [illegible] death being due to collapse and coma. The mort[illegible] born of diabetic women exceeds 40 [illegible] It [illegible] that the fœtus dies soon after [illegible] dropsical. In one case the [illegible] facts a[illegible] the subject of [illegible]

T[illegible] The [illegible] treatm[illegible] diabetes in the pregnant patient does not differ from that usually adopted under other circumstances. If the symptoms are pronounced, and especially if they are not relieved by treatment, the pregnancy should be terminated.

CARDIAC DISEASE.

The physiological hypertrophy of the heart in pregnant women testifies to the increased work put upon it during gestation. Pre-existing cardiac lesions are liable to be aggravated by pregnancy, and in advanced disease the heart may seriously be crippled in the later months. The circulatory disturbance usually begins near midpregnancy. The danger is especially great under the added strain of labor, and it culminates in the third stage, when a large volume of blood is abruptly thrown upon the venous side by the uterine retraction, causing dilatation of the right heart. Yet in a considerable proportion of cases the heart, even though damaged, proves equal to the increased demand upon it, and apparently sustains little or no added injury.

The mitral valve, either alone or with others, is oftenest affected. Of 92 cases of valvular disease in pregnancy collected by Porak, the mitral valve alone was diseased in 57; both mitral and aortic valves were involved in 22. In 22 there was mitral insufficiency, in 13 mitral stenosis, and in 22 both conditions were present; in 13 the aortic valve only was diseased, insufficiency existing in 9, stenosis in 2, and the double lesion being present in 2.

Prognosis. Most fatal of the valvular lesions in pregnancy is mitral stenosis. Eight of the thirteen cases recorded by Porak terminated fatally. McDonald reports fourteen cases with nine deaths. In double mitral lesions the mortality is still greater. The death-rate in aortic disease is from 23 to 25 per cent., while in mitral insufficiency, the best borne of all the valvular affections, the proportion of deaths is not far from 13 per cent.

The period of greatest danger is the close of the second stage of labor. During the pains of this stage the venous circulation is impeded by the prolonged and violent expulsive efforts. The right heart is dilated, as indicated by the swollen veins of the neck and the cyanotic hue of the face. At the moment of expulsion or directly after, as the uterine sinuses are emptied, an additional volume of blood is thrown upon the already overloaded right heart, often with fatal effect. Obviously the prognosis must depend largely on the condition of the myocardium. With full compensation the patient may pass safely through pregnancy and labor. In advanced cardiac disease the prognosis is always bad. In marked failure of compensation, with dilatation of the right heart and much pulmonary congestion or œdema and albuminuria, it is extremely grave. Owing to the increased labor imposed upon the heart in the later months of pregnancy, existing cardiac disease is, as a rule, permanently aggravated by child-bearing.

All forms of heart disease predispose to abortion. In a large proportion of cases the pregnancy terminates prematurely. The immediate cause of the abortion may be excess of carbon dioxide in the blood or placental apoplexies.

The tendency to post-partum hemorrhage is increased by the circulatory obstruction, yet moderate bleeding at the close of labor is conservative by relieving the venous engorgement.

Symptoms. The symptoms of valvular disease vary according to the extent of the lesion, the valves affected, and the amount of compensatory hypertrophy which is present. They do not differ essentially from the usual manifestations of similar lesions under other circumstances. Palpitation, dyspnœa, and more or less præcordial distress are common in the later months of pregnancy, even in the milder forms of valvular disease.

Dilatation of the right heart is attended with visible pulsation of the veins of the neck and with epigastric pulsation. The first sound is weak and the area of dulness is increased. Pulmonary congestion or œdema and venous stasis in other viscera frequently develop, especially during labor.

Treatment. Peter says a woman with heart disease should not marry; if she is married she should not become pregnant; if she has passed through one or two pregnancies safely she should not again become pregnant; and, finally, if she gives birth to a child, she should not be allowed to nurse it. Peter's dictum, however, is too sweeping. It should be limited rather to the grave forms of valvular defect and to incompetence of the heart-muscle.

The hygienic management of cardiac disease in pregnancy is important, and consists in the avoidance of undue exertion, physical or mental, of sudden chilling of the surface of the body, and in the removal, if possible, of all sources of nervous disturbance.

The medicinal treatment either during pregnancy or labor is for the most part symptomatic. Iron, arsenic, or strychnine are frequently useful as tonic measures. For cardiac supports strophanthus in 5-minim doses of the tincture several times daily, or the tincture of digitalis, 5 to 10 minims three times daily, may be used, or digitaline may be given in $\frac{1}{100}$ to $\frac{1}{60}$ grain doses. Trinitrine, by preventing the contraction of the arterioles caused by digitalis, is a valuable auxiliary to the latter drug.

The obstetric management of serious cardiac disease will often tax the physician's skill and judgment. When the woman is in imminent peril the artificial interruption of pregnancy is demanded. Yet, when the conditions are bad enough to justify interference, even a premature labor is attended with great danger. Kaltenback regards uncompensated valvular disease as a positive indication for the induction of labor. Fehling would terminate the pregnancy when, in addition to the non-compensation, there is chronic bronchitis with marked emphysema. In the presence of such pulmonary congestion and œdema, with extensive visceral complications, general anasarca or ascites, and extreme dyspnœa, and especially if the symptoms become more pronounced notwithstanding treatment, the uterus should be emptied. Winckel, on the other hand, speaks discouragingly of the results of premature delivery.

The indications after labor has begun are to deliver the patient with as little exertion on her part as possible. Chlororoform should be used to diminish violent effort and to limit shock. After sufficient relaxation forceps should be employed. Should the dilatation be slow, it may be hastened by artificial means; manual dilatation, or, if the emergency requires, Dürhssen's incisions should be practised. Meantime, the heart should be braced with one or more of the usual cardiac supports—strophanthus, spartein, digitalis, trinitrine, and caffeine. These agents act most promptly and efficiently if given by the hypodermic method. Sudden asystole at the end of the second stage is best met with inhalation of nitrite of amyl and with hypodermics of ether or strychnine. When these measures fail, from 10 to 16 ounces of blood should be taken from the arm. Ergot should be proscribed, since it contracts the arterioles and increases the circulatory obstruction; moreover, it limits the blood loss from the uterus. Moderate bleeding after delivery is beneficial. When not sufficiently free it should be favored by the use of douches of warm sterile water, at a temperature not exceeding 40° C. (105° F.). If during the labor the patient suddenly expires, the child being viable, accouchement forcé, or, if need be, Cæsarean section, should at once be performed, in the hope of saving the child.

PART VII.

PATHOLOGY OF THE PUERPERIUM.

CHAPTER XXV.

ANOMALIES AND DISEASES OF THE BREASTS AND NIPPLES.

Normal Data. The reader will recall that each mamma empties its secretion through the nipple by means of about twenty ducts in direct communication with the mammary acini. These ducts are lined with cuboidal epithelium.

The acini are composed of saccular dilatations of the terminal ends of the smallest ducts, and possess a membrana propria lined with characteristic secretory epithelium. White, fibrous and adipose tissues surround the acini in varying proportions, according to age and the individual. Like all other active glands, the mammæ are rich in bloodvessels, lymphatics, and nerves.

The blood-supply is peculiar in that the ducts are surrounded by a vascular plexus, instead of parallel vessels inosculating with one another as in the voluntary muscles.

The nerve-endings have never been conclusively traced; but they doubtless terminate in the parenchymatous elements.

The lymphatics communicate ultimately with a single large channel extending to the axilla.

The breasts reach fullest development during pregnancy, when the glandular epithelia become enlarged and filled with milk globules.

Anomalies.

Supernumerary nipples and breasts, defective development of the nipples, and absence of one or both breasts are met occasionally. Complete absence of the gland is rare, but imperfect development is common. There are but few cases reported of hypertrophy of the breast. It is said that lactation has been known to reduce an abnormally enlarged breast. Polymastia (supernumerary breasts or nipples) is common. The location varies, but is usually below the true breast. There may be one or more supernumerary breasts or nipples, which have been recorded as being situated either in the shoulders, umbilicus, back, groin, labium, or buttock. One case was reported as having nine breasts; another, ten nipples. These anomalies are of obstetric interest only in so far as they may affect the woman's ability to nurse her child.

Defects of the nipples are especially important, as they may interfere with nursing. Both congenital and acquired deformities are common.

The nipples may be primarily small, sunken, or inverted, or imperfectly developed from pressure of faulty clothing.

The nipple lesions of lactation are largely the result of defective development, and consequent difficulty in nursing.

Sore Nipples.

Nipple lesions of greater or less severity occur in nearly 50 per cent. of nursing women, and begin usually within the first few days after suckling is inaugurated, being due to maceration and abrasion of the cuticle by the infant. They are of clinical importance by virtue not only of the exquisite suffering they may occasion during nursing, but especially of their etiological relation to mastitis. Mere erosions may soon heal and give rise to no further trouble. While they persist they are often extremely painful, and they commonly lead to more serious lesions.

Fissures occur at the base or top of the nipple. The latter run transversely to the axis of the breast. Ulcers not infrequently result, and when milk-ducts open into the base of an ulcer they are occluded as the ulcer heals.

Etiology. Defective development and deformities, by rendering nursing difficult, frequently act to increase the injuries inflicted on the nipples during suckling. Needless maceration of the nipples by too prolonged and frequent nursing is often the cause of erosion and fissure. Soor or aphthæ (thrush, sprue) in the child's mouth exposes the nipples to infection. Uncleanliness of the nipples in the later weeks of pregnancy, and especially during lactation, is a common source of septic invasion.

Treatment. PROPHYLACTIC. Prevention should begin in the management of pregnancy. The presence of defective nipples should not escape the antepartal examinations. Teach the woman to draw them out daily during the last two or three months of pregnancy with clean fingers or by means of a suitable breast-pump. This practice not only tends to develop the nipples, but also prepares them to withstand better the mechanical violence of beginning nursing. The mother should be warned of the injury that may be done by tight clothing.

For at least a month before labor special attention must be paid to the cleanliness of the parts. Daily bathing in warm water and a bland soap, or with a solution of borax—a tablespoonful to the pint of boiled water—is a valuable precaution. The use of agents for hardening the nipples is not advised. There is reason to doubt that bathing the nipples with alcoholic and other astringent solutions is a suitable preparation for nursing. It is more than probable that hardening the skin predisposes it to cracking. It would seem more rational to keep the nipples as supple as possible. The application of fresh cacao butter or some equally bland emollient, as lanolin, after the daily cleansing promotes this end.

Dr. J. M. Mabbott praises the following treatment: Daily for a month or more before labor the patient anoints the nipples at night with lanolin, working it thoroughly into them by kneading them between the thumb and fingers. In the morning the nipples receive a prolonged scrubbing with a soft nail-brush and pure soap and water, care being taken not to abrade the skin surfaces. The nipples are then rinsed and dried.

When nursing begins the delicate cuticle of the mammilla may be broken and abraded, and during the post-partal month the septic exposure is especially increased by the contact of hands liable to be infected from the lochial discharges. The occurrence of thrush or of ophthalmia in the child obviously adds to the risk of infection. Hence the need of a cleanly management of the nipples during the first weeks of lactation. The avoidance of septic contact is clearly important. Bathing with a boric-acid lotion before and after each nursing is specially advised. A saturated aqueous solution is not too strong. Cleansing the infant's mouth with a similar wash before and after each nursing is in the interest of both mother and child. Care must be taken not to abrade the buccal mucous membrane, lest the practice invite the trouble which it aims to prevent.[1] More active antiseptics are more effectual, but they require greater care in use. The writer has employed with satisfaction a nipple dressing wet with a mercuric iodide or chloride solution, 1–10,000 or 1–5000; the mercurial must be rinsed off with boiled water or with the boric-acid solution before nursing.

To limit the injury done by maceration and bruising, a single nursing need not occupy more than ten or, at the most, twenty minutes, and regularity should be insisted upon. See that both breasts are nursed, each on an average from seven to ten minutes.

The cacao-butter or some other similar inunction may be employed with advantage after each nursing, the surfaces having first been cleansed as already detailed.

CURATIVE TREATMENT. Excoriations and slight fissures heal in most cases under proper and timely antiseptic treatment. An ointment of equal parts of subnitrate of bismuth and castor oil may be used as advised by Hirst. The writer has generally preferred to this a similar ointment made with the glycerite of starch. But the glycerin preparation may not always be well borne by the skin. The ointment should frequently be sterilized by heat. Before applying, the parts are disinfected. A valuable agent for the latter purpose is the hydrogen dioxide. While a host of nipple lotions and other applications have been recommended in these affections, none is more rational or promises better results in ordinary cases than some simple but carefully executed antiseptic plan of treatment.

Pain during nursing may be relieved to some extent by pencilling the nipple five or ten minutes before the child is put to the breast with a 1 to 5 per cent. cocaine solution. The solution ought to be heated to the sterilizing point shortly before using.

A 1 or 2 per cent. carbolic lotion applied in the same manner is sometimes useful as an anæsthetic. The addition of one-tenth its volume of glycerin prolongs the action of the lotion and keeps the skin soft.

After the application of drugs the nipples should always be cleansed before nursing.

In excoriations and fissures that are not too sensitive and do not bleed readily, nursing through a nipple-shield may be tried. The shield protects the nipple from the friction, and to some extent from the maceration of suckling. Unfortunately for this method, the child may not accept the substitute for the natural nipple. If artificial nipples are used, it is important that they be rendered aseptic by boiling for five minutes in water immediately before using and not handled with unclean fingers.

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[1] An easy and reliable method is to wrap a small piece of absorbent cotton or soft cheesecloth around one of the fingers, and, after saturating it with the boric-acid wash, to rinse out the child's mouth carefully. This allows all surfaces of the mouth to be bathed.

Similar protection to the nipple lesions is afforded, though in a less degree, by coating the affected surfaces with a pellicle of compound tincture of benzoin.

Deep and painful fissures may be treated with the solid stick of nitrate of silver. The entire raw surface should be touched. The lips of the fissure being well separated, the caustic point is drawn slowly through it. This is repeated, if required, in three or four days. Care must be taken that no excess of moisture is present, otherwise the dissolved silver salt may trickle over the surrounding surfaces and healthy structures be injured. A serious objection to this treatment is the exquisite pain it causes. This may in great measure be prevented by first benumbing the part with a 4 per cent. cocaine solution. After the application of the caustic the nipple may be covered with a piece of lint well wet with the anæsthetic lotion.

Instead of the solid stick, two or three applications daily of an aqueous solution of the nitrate of silver may be preferred. In the strength of 1 or 2 per cent. it causes little pain and frequently does good service. The affected nipple should be rested, if possible, for twenty-four hours or more.

When other measures fail, suspension of nursing for one or two days sometimes succeeds. If both breasts are affected each may be rested on alternate days.

It is very rarely that the nipple lesions are so rebellious to well-directed treatment as to necessitate the total abandonment of nursing.

Mastitis.

Mastitis occurs in 5 to 6 per cent. of nursing women, oftenest in primiparæ, and may or may not terminate in suppuration. In the great majority of cases it begins within the post-partum month.

Etiology. That the essential factor in mastitis is sepsis does not admit of discussion. Here, as elsewhere, the suppuration and the local morbid process which leads up to it are due to infection. Obviously the offending organism may be any of the pus-producing germs. Most frequently found, according to Escherich, are the staphylococcus aureus and albus. The streptococcus of pus is next in order of frequency. The lochia is a prolific source of infectious material, which during childbed is added to the usual septic exposures.

The predisposing causes and the methods of infection are questions involved in some dispute. Impaired general health and local mechanical injuries, diminishing the resisting power, are obviously important predisposing factors in many cases. Contusions of the breast from blows or from bruising with the breast-pump may become the starting-point of mastitis.

The influence of milk stasis, which is so large a factor in the popular belief, is differently estimated by obstetric writers. Olshausen denies that it causes inflammation. Roser holds that milk retention is a result, not a cause, some of the lactiferous ducts being occluded by inflammatory swelling of surrounding structures. Others think milk stasis may favor the growth of bacterial organisms. Possibly retention by damaging the delicate endothelium of the lacteal ducts in the engorged areas may become a factor in the septic invasion. Engorgement alone is not a competent cause.

That the nipple lesions so common during early lactation hold a prominent place among the predisposing causes of infection does not admit of doubt. Fissures of the nipple and even the abrasions, which are almost invariably produced by the friction of the child's tongue and lips in the first weeks of lactation, expose the lymphatics directly to the entrance of septic organisms.

That the morbific agent in a considerable proportion of cases enters by the lactiferous tubules is beyond question. It is well known that pathogenic germs may penetrate healthy mucous or serous surfaces. Frequently the way is made easy by the injury done by milk engorgement or by mechanical violence. That pyogenic bacteria which have gained access to the milk ducts from without may pass into the deep structures of the gland, even against the milk stream, cannot be doubted. Recent observations have shown that staphylococci are frequently present in the milk of perfectly normal breasts. Palleski examined the milk of twenty-two healthy nursing women and found staphylococcus albus in ten. Similar observations have been made by other investigators. Honigman and Ringel contend that human milk normally contains the staphylococcus pyogenes albus and aureus. That mastitis occurs so infrequently, despite the frequent presence of the microbic causes of suppuration, must be explained by the fact that a favorable condition of the soil as well as the presence of the germ is necessary to bacterial growth.

A possible source of mammary inflammation which is not often mentioned by obstetric writers is infection through the blood channels. Karlinski declares that micro-organisms from the cavity of the uterus in process of involution may be found in the blood. Escherich affirms that staphylococci which have gained access to the blood through infection of the genital apparatus are excreted in the milk as well as by other channels. In the milk of infected puerperæ he found, without exception, staphylococcus aureus or albus. That infection of injured mammary tissues is possible from sepsis in remote organs is abundantly established by clinical observations and by the experiments of numerous observers on the localization of septic processes. Not alone direct injuries of the breast invite such localization, but there is reason to believe that general pathological conditions, even exposure to cold, may act in this manner.

We must conclude that the infecting organisms may reach the gland structures through the lacteal ducts, the lymphatics, or the bloodvessels; that nipple lesions, milk stasis, contusions of the breast, impaired general health, probably chilling, and genital or other remote infections are among the predisposing causes.

Symptoms. The essential symptoms of mastitis are pain, swelling, and localized tenderness in the breast, together with more or less rise of temperature. The attack is frequently ushered in by a chill or slight chilliness.

When pus forms fluctuation may usually be detected, and a deep red or bluish discoloration of the skin is observed at the place where the pus comes nearest the surface. Yet fluctuation may be absent in deep-seated suppuration, and the evidence usually afforded by the appearance of the skin may be wanting, at least for a time, after pus is present.

Forms. There are three principal forms of mastitis: Glandular, subglandular, subcutaneous. To the latter two the term perimastitis would perhaps more properly apply. The differential diagnosis of these varieties of mastitis depends upon the source of the infection and the location of septic foci, together with the degree of systemic disturbance.

In the subcutaneous form the lesion is usually single and differs little from superficial phlegmon in other parts of the body. In the glandular form more pain and more constitutional disturbance are present than in the subcutaneous variety; prodromal chill is usual; the lesion is often multiple; the gland is indurated. In the subglandular form the pain is deep seated and more intense, temperature persistent and high, the gland not indurated, and, when suppuration has occurred, it floats upon the surface of the fluid. Pus is detected by passing an aspirating needle behind the gland. Suppuration may eventuate in any of the forms, depending upon the patient's lack of power to resist the infection and upon the quantity, nature, and virility of the invading parasites. It must not be forgotten that two or all forms may coexist.

Treatment. PROPHYLACTIC AND ABORTIVE. Milk engorgement is combated by training the child early to nurse. Congestion or engorgement occurs, usually on the second or third day. A slight fever and some distress referred to the breast are usually the first symptoms. The infant should receive its first lesson as soon after birth as the condition of the mother will permit, usually within six or eight hours, and no effort should be spared in teaching the child to suckle before the milk secretion is fully established. The use of the breast-pump, as a rule, is unsatisfactory. It frequently fails, and is liable to bruise the breast.

At the hands of a skilful nurse, massage is often useful for the relief of overdistention, either of the entire breast or of single lobules. It is contraindicated in the presence of inflammation, and is permissible only when not painful. The breasts should be well oiled in order that the nurse's efforts be not expended in mere friction, but be rather a deep kneading directed to the gland. The stroking is practised in the direction of the lactiferous ducts, from the base of the gland toward the apex.

In hypersecretion the compression-binder is an extremely valuable measure. A well-made Murphy binder is especially recommended. It is applied firmly, the pressure being evenly distributed over the breast by a moderately thick layer of cotton-wool under the binder. An opening in the centre of the cotton compress prevents injurious pressure upon the nipple. Compression is useful both as a preventive and an abortive measure in mastitis.

Topical applications of oleate of atropia are effectual for diminishing the milk secretion, but they must be used with care lest the secretion be too much repressed or the patient present an idiosyncrasy to belladonna even in small physiological doses. Saline catharsis and the restriction of liquids are especially indicated in over-free secretion.

Essential for the prevention of mastitis is the preventive and curative treatment of nipple lesions. As has already been said with reference to the prophylactic care of the mammillæ during the early weeks of lactation, it must be remembered that prolonged maceration of the nipple in the child's mouth is injurious. A single nursing need not occupy more than ten or, at the most, twenty minutes, and regularity should be insisted upon.

A part of the prophylaxis which must not be overlooked is addressed to the general health of the patient. Tonics are indicated in the majority of convalescents from childbirth.

Applications of unguentum Credé may be of service. About a drachm should be rubbed well into the breast night and morning.

TREATMENT OF SUPPURATION. When pus forms in either variety of mastitis it should immediately be evacuated. An anæsthetic is required except in simple subcutaneous abscess. Ethyl chloride (Kelene) may be used to freeze the tissues over the area to be incised when the abscess is not too extensive, and when the type is either subcutaneous or glandular. The incision should radiate from the nipple, to avoid severing the milk-ducts, and should be large enough to admit the finger freely. When but one incision is made, it is to be located at the most dependent point of the abscess-cavity. It is well to avoid the areola, unless the incision can be kept wholly within that area. Otherwise an unsightly scar results, owing to pigmentation of the cicatrix.

The finger is then introduced and the cavity thoroughly explored. If the abscess be large, and especially if several loculi are found, counter-openings should be made at remote points. The cavity or cavities are then thoroughly irrigated with the normal salt solution or with peroxide of hydrogen. A drain of washed-out strip iodoform gauze is placed in each opening, and a large compress of aseptic cotton or cheesecloth is applied and held firmly by a breast-binder. The dressings must be changed daily for six to eight days and the irrigation, as a rule, repeated. By the end of that time the incisions may generally be allowed to close unless pus is present. One or two soft flexible rubber drainage-tubes for each opening may be substituted for the gauze, if preferred, after the first few days. The tubes should be shortened from day to day as the abscess cavity diminishes.

One of the most valuable agents in aborting mastitis is the early and continued application of cold, either by the ice-coil or, preferably, by the ice-bag. The bag should not be placed directly on the breast, but should have two or three layers of flannel between it and the surface of the breast. Continued cold applied in this manner is almost a specific for pain, and tends also to abort suppuration. It is possible that the cold may limit the rapid development of the micro-organisms, or at least check their growth from the thermal conditions present.

Tonics, milk punches, and especial attention to the regularity of the bowels are indicated.

Agalactia.

The causes of agalactia, or diminution of milk secretion to a degree below the normal, are general and special. Adynamia of any origin may be accompanied with insufficient milk secretion. This may be due to diarrhœa, fevers, hemorrhages, serious organic lesions, insufficient nourishment, or mastitis. On the other hand, congenital or acquired malformations may be the cause. Lack of development of the glandular tissue is one of the most frequent causes, in which heredity plays an important part.

In the cases dependent upon general conditions every effort must be made during pregnancy to restore the patient's tone and vigor; and after labor liberal quantities of fluid—milk preferably—must be taken. Malt, Russell emulsion, somatose (3 or 4 teaspoonfuls daily), and foods containing phosphorus are believed to be useful. Thyroid extract, gr. j 3 to 5 times daily, is said to increase the quantity and to improve the quality of the milk. Massage of the abdomen from the pelvis to the breasts, including the latter, it is claimed increases the amount of blood brought to the mammary glands. The breasts may be stimulated by massage and by daily applications of faradism.

Congenital conditions are not amenable to treatment; whereas, acquired malformations, such as stenosis of milk-ducts, or parenchymatous degenerations due to indurative processes, can be modified in some cases by timely treatment.

As inflammatory lesions are the common local causes of these mammary changes, it is of first importance to prevent their occurrence, and if not successful to limit them as much as possible.

Galactorrhœa.

Galactorrhœa is an excessive secretion of milk which persists after weaning. The cause is unknown. The quantity of milk is very large and its quality thin and watery. One or both breasts may be affected, and the condition may seriously impair the general health.

TREATMENT. Treatment consists in firm compression of the breasts with a breast-binder, the exhibition of iodide of potassium, gr. x t. i. d., and the persistent use of ergot for a considerable period. Oleate of atropia may be applied locally with caution. General tonics and hæmatinics are especially indicated.

Galactocele.

Galactocele is a condition in which a mammary acinus becomes distended with milk. This may be due to congenital conditions, such as absence of the duct, stenosis, or atresia; or may result from inflammation. It is single or multiple, and may affect one or both breasts.

TREATMENT. Treatment is indicated where the condition is progressive, and consists either in laying the cyst open under aseptic precautions, and treating it as an abscess-cavity, or dissecting it out and closing the wound at once.

It must not be forgotten that galactocele sometimes undergoes spontaneous cure, the milk becoming inspissated and, finally, inclosed in a shrunken sac, and having the consistence of sebaceous matter.

Polygalactia.

This is an excessive secretion of milk during lactation, and is to be distinguished from galactorrhœa, in which the milk secretion persists after weaning. It is often sufficient to affect the general health.

TREATMENT. Restrict diet, especially liquids; also regulate the patient's food. Apply compression binder, give salines, and, if necessary, evacuate the superabundant amount of milk by breast-pump. Massage is contraindicated except in "caking."

Hyperlactation.

This occurs when the child is nursed beyond the weaning age. A recent case was reported at one of the Brooklyn hospitals; a negro boy three and a half years of age was sent by his mother to the hospital to be weaned.

Oftentimes the health of the mother in such cases suffers markedly, so much so as to demand a change of climate.

Actual treatment consists in weaning the child, prescribing tonics for the mother, and a compression-binder for a short period. The treatment advised in galactorrhœa is indicated in these cases.

CHAPTER XXVI.

PUERPERAL INSANITY.

THE term *Puerperal Insanity* is applied to the psychoses of pregnancy, labor, or the puerperium. It does not indicate in itself any single form or type of insanity, but refers only to the etiology. Usually the form of mental derangement is either a melancholia or a mania.

As in so many other mental diseases, there must be a prepared soil, which consists in an hereditary predisposition, and here the likeness to the so-called periodical and recurrent insanities is most pronounced. While *primiparæ* are most likely to develop such mental derangement, there are many women who have repeated attacks of puerperal insanity as an accompaniment of subsequent accouchements, and doubtless its crisal development is oftentimes merely an exacerbation, the patient's mental state never being after the first attack an entirely normal one. The number of women who for the first time become insane after the second or third parturition is small in comparison with those whose disorder attends the first confinement.

Etiology. Undoubtedly there are a large number of factors both physical and mental that contribute to the production of insanity at this important epoch, and while certain variations take place in the symptomatology of the insanities coincident with the pregnant state or that following birth, the bodily and mental causes very often play a continuous part. Much stress has been laid upon the sense of shame and fear connected with the birth of an *illegitimate child*, and undoubtedly the worry and attendant suspense lead to such mental exhaustion and disorder as to end in the overthrow of the patient's ordinary mental condition. Strange to say, however, in the majority of cases there appears not only to be a gradual evolution of symptoms, except in a very small number of melancholic cases, but there are mania and confusion which are suggestive of a physical cause presently to be more fully referred to. It cannot be gainsaid that where conception has been the result of guilty intercourse, and where attempts have been made to produce criminal abortion, there may be not only very great mental distress and apprehension, but an undermining of physical strength, which are sufficient in themselves in certain neurotic individuals to lead to insanity. In Scotland particularly the influence of illegitimacy is very great, 25 per cent. of all cases occurring in the experience of one writer being those in which the offspring were illegitimate. This, according to Lewis, does not appear to be the case in England, where 61 of 66 cases observed by him were married women. After all, the importance of this element depends very much upon the moral sensibility and religious training of the community.

Among other *psychical influences* concerned in the creation of this form of insanity may be enumerated the development of the maternal instinct, the tortures of poverty, and the suffering that the woman may undergo as the result of neglect or cruelty of her husband. Among the physical causes may be mentioned certain conditions of *exhaustion* which are due to over-exertion during the months previous to delivery, the loss of blood at this time, or certain imperfectly understood forms of autotoxis. *Albuminuria*, which in former years was supposed next to local septic infection to play a part that would fully account for the puerperal psychosis, is not nowadays regarded as a sufficient explanation; in fact, the urine of the puerperal insane, as a rule, shows the absence of albumin, and there are many cases where the disease develops in women whose kidneys have from the first been unaffected. The dangers of *septic infection* from the uterine cavity itself have been equally exaggerated. Lusk, whose conservative opinions are well known, is disposed to take the view that septic infection is more likely to take place when bacteria are introduced from outside the body, and suggests that the toxæmia due to the agency of the bacterium coli is often at the bottom of wrongly ascribed toxis.

The writer's recent investigations as to the origin of insanity which is due to the *absorption of the products of intestinal putrefaction* lead him to believe that the cause of many cases of puerperal derangement is to be found in the large intestine, and that the acute symptoms, which are very characteristic, may be traced to the excessive formation of combined sulphates, and are accompanied by the presence of a large amount of indican in the urine. Whether the initial cause be exhaustion or mental worry, the disordered metabolism of proteids is a likely consequence. This theory is borne out by the investigations made by Lewis about seven years ago, namely, that there was a very decided reduction in the amount of hæmoglobin, which in five of his cases varied from 20 to 78 per cent. of the standard of healthy blood, although in one of these cases the oligochromæmia was due to post-partum hemorrhage. In all the five cases there was a lowered corpuscular value, and in one maniacal patient a rather sudden reduction attended the maniacal outburst. The well-settled conclusions arrived at by Sir Andrew Clark, Solkowski, and others, and verified by the writer's cases, show that the absorption of the products of bacterial death invariably result not only in diminished hæmoglobin, but in various alterations in the number and structure of the corpuscles themselves. As familiar causes may be mentioned *stoppage of the lochia* and the consequent retention of septic material, subsequent inflammation of the uterus itself, and the various accidents of the puerperal state, *exhaustion after a protracted labor*, an *extensive rupture of the perineum*, the suffering *incident to the use of instruments*, and the formation of *abscesses of the breast*. In a large proportion of cases the cause is to be sought in a septic or toxic condition.

Symptoms. Two forms of puerperal insanity are ordinarily recognized: maniacal and melancholic, the former being much more common than the latter, the percentage varying from 70 to 80 of all the cases, and in most instances the excited or depressed state differs but little from the familiar derangement due to various non-puerperal causes. There are certain peculiarities which are so constant, however, as to be considered characteristic by many, notably the erotic manifestations and the destructiveness. The hallucinations and delusions are of a lively and rapidly formed kind, and it may be said that, whether the patient is excited or depressed, *painful* emotional states are apt to prevail. The melancholia may be of slow or rapid formation, and if it has a dominant feature it is the tendency to suicide, which is common.

Irregular mental disturbances which are so brief as not to fall under the ordinary heads of insanity, consist in delirium and temporary disturbances of a confusional nature. There is also in subjects possessing the hereditary tendency a variety of insanity characterized by the commission of impulsive acts, for which the person is very often held responsible, her ordinary conduct showing very little or no change. Within the first week after delivery the woman may present changes and an insanity develop of a most dramatic and violent nature.

There may or may not be a prodromal condition of ill health, manifested by loss of appetite, indigestion, constipation, and flatulence; but such is apt to be the case. The patient's color is usually pale, the pulse becomes irritable and quick, and a restlessness is shown which grows, and is associated with irritability, tearfulness, and pitiful complaints in regard to petty annoyances. Sleep becomes disturbed and broken, and the patient is annoyed by bright lights, noises, the slamming of doors, and is apt to be querulous and fault-finding. She expresses no interest in her child, and, in fact, does not care to see it, and when it is placed by her she is either indifferent or asks for it to be taken away. She turns against her husband, whom she subsequently accuses of infidelity; she becomes suspicious of those about her, and may say that her food is poisoned and refuse to eat it. As the condition deepens so does the excitement, while rapidly formed delusions of persecution—which at first are systematized, but afterward become disorderly and without foundation—are expressed. Auditory hallucinations as well as those of the other senses are constant, and lead her to express a fear of injury and contamination. In well-developed cases the articles about her are declared to be smeared with blood. Evil faces peer at her from every side, and she hears voices urging her to kill herself or some one else. Some women manifest exceedingly erotic eccentricities of conduct, which amount to nymphomania.

Refined and gentle women will make indecent proposals and write foul scrawls, expose their persons, and subsequently defile themselves and their bedclothing with their excrement. There are some cases of slower growth where the initial disturbance consists in a stolid silence, with a great deal of suppressed excitement which finally bursts forth. Cases are known in which women remained absolutely mute for a week or more, concealing their delusions, and ultimately, within a remarkably brief space of time, became incoherent and violent. In the depressed form of trouble there may be slowly developed delusions which sometimes have a religious coloring, and such patients are apt to accuse themselves of crimes, believing that they are the special objects of divine condemnation and are hardly fit to live. It is not at all unusual for such a patient to declare that her baby is not her own, or if it is, that it must be destroyed as a sacrifice, and that she must herself kill it, which she does. Sometimes, as a result of delusion she kills herself, or tries to, and it is not unusual for her to do this, believing that she is a burden to her husband and friends, although in the majority of cases, as has been said, the puerperal insane distrust those about them, and are filled with their own unhappy importance. The concealed form of the disease is one in which the patient may manifest a slight depression which does not reach the dignity of simple melancholia, and in which her hysterical conduct or derangement, regarded, as a rule, as ordinary neurasthenia, in reality disguises a most serious psychosis which is appreciated for the first time when some sudden and perhaps successful attempt at suicide, or some impulse resulting in destruction of her child or another person, awakens every one to the gravity of the masked disease that has perhaps existed for a long time.

The insane crimes of puerperal women are nearly always of a nature to suggest an unbalanced mind, and there is none of the concealment that belongs to child murder committed by sane persons.

Regis refers to the fact that homicide is a feature of post-partum insanity, while theft and other misdemeanors which imply a sudden instigation or a desire to satisfy, are chiefly features of ante-partum insanity.

There is no doubt of the fact that throughout the puerperal state the woman has diseased appetites and impulses, and though they may not rank very high as evidences of mental deterioration, and may disappear entirely after the re-establishment of menstruation, they at some time or other find expression in disorderly acts, some being of a criminal nature. Destruction of property, incendiarism, and the impulsive propensity to steal are not infrequently manifested, and abortive attempts at suicide lead to newspaper publicity and possibly to legal prosecution. So far as the physical evidences of puerperal insanity are concerned, we find little that is distinctive or is not associated with the ordinary insanities. The indications of malnutrition in the acute, excited and depressed psychoses are generally exaggerated, and those signs of loss of tone of the bodily functions which are the expressions of exhaustion appear much earlier than they otherwise usually do. Early and obstinate constipation, heavily loaded urine, and other indices of gastro-enteric disturbance usually commence almost as soon as, and often before, the excitement is at all marked, and may eventually resemble the so-called typhoid symptoms of various states of exhaustion. Pallor is a characteristic appearance which is common to certain other toxic insanities; the skin often has a glossy, drawn look, and the breath the so-called starvation odor. Some women at a very early time rapidly sink into a delirious condition, with occasional periods of consciousness, but without any rise of temperature, the state being erroneously called puerperal fever; in reality it is a toxæmia which varies in intensity of expression with the rapidity of absorption and the virulence of the septic poison. Sometimes the mental symptoms, as has been said, are immediately connected with the stoppage of the lochial discharge; but the discontinuance of the latter is more often an effect than a cause.

Some writers regard stuporous melancholia to be the type belonging specially to puerperal insanity, which, however, is a view the writer can hardly take, unless the familiar mute form of the disease is to be so regarded; this seems improbable, as the subjects of the latter so often eventually express a certain intensity of feeling which undoubtedly exists in the earlier stages in a repressed form, even when the patient is most silent.

Prognosis. In a large number of cases there is a comparatively prompt recovery, especially in puerperal mania. The prognosis is not nearly so good in melancholia; but, of course, in both conditions much depends upon the treatment. Where an hereditary groundwork exists the situation becomes much more grave, and the danger of non-recovery is increased by the occurrence of two or more attacks. Regis does not regard any form of puerperal insanity to be as curable as simple generalized insanity. He considers that the forms occurring during gestation or labor are much more likely to get well than when the affection develops at a later period, believing that the insanity of lactation is much more serious.

So far as time is concerned, much depends upon the duration of the symptoms and upon the age of the subject. If the physician adopts prompt measures the condition may be cut short within a brief space of time, especially if the patient be a young woman; but if, as is often the case, she enters an asylum after the existence of a mania or melancholia for several months, her prospects are rather bad, for a certain mental involution has taken place which is likely to be permanent and progressive. As to age, it may be held that if puerperal insanity develops in a woman over thirty the prognosis is much more unfavorable. Lewis's figures, which may be taken, show that the recovery-rate may even reach a percentage of 80, while 8.5 per cent. represents the mortality. Of the 80 per cent. who recovered the greater number got well before the sixth month, there being 37 out of 68 cases; the others slowly recovered. It would also appear from his tables and those of Clouston that the sooner patients entered the asylum and were treated, the more rapid was their recovery. So far as the writer's experience is concerned, those who manifested suicidal tendencies or in whom the delusions were fixed and limited presented a form of the disease which is the least curable. On the other hand, in the ordinary cases, where the delusions and hallucinations are general and unstable, the prognosis is fairly good. Should a case progress, the termination of dementia is not usually so rapid as that of other forms, in this respect resembling the limited delusional insanities.

Treatment. Very much tact and care are needed in the early management of puerperal insanity, which is often difficult because of the situation of the patient and the prejudices of the family. The interference of an anxious husband is too often apt to tie the hands of a physician and to prevent him from adopting and using the wise measures of restraint that are demanded. Much of this may arise from the non-recognition of the serious nature of the complication, the friends of the woman believing it to be some temporary disturbance which may be an unimportant symptom of the puerperal condition, that will disappear in a few days. The early irritability and malaise of the woman are rarely appreciated, and the solicitous husband is apt to force his society upon his wife or to insist upon leaving the child in bed with her, despite her expressions of disgust or indifference. Anxious and sympathetic friends insist upon paying visits, and injudicious clergymen attempt a moral reform and proffer religious consolation, which has either no effect at all, or a harmful one, upon the already deranged woman. One of the first duties of the physician is to leave her alone with her nurses, who should be competent and experienced, and isolation should be rigidly enforced.

The isolation of the patient should last for a considerable time, and even when committed to an asylum it is best that she should be kept away from other patients, especially those who are apt to excite or encourage her delusions.

All things being considered, there is no reason why a patient of this kind should be removed from home, even if it were proper for her to leave her bed. But where proper facilities for nursing and restraint are not available, removal to a well-ordered asylum should be insisted upon as soon as the local conditions will permit and the diagnosis is made with certainty. It seems hardly necessary to refer to the importance of removing every possible agent with which the patient might injure herself or others; but the frequent tragedies that so often occur through neglect of this precaution must excuse a repetition of what may seem to be trivial advice. *The patient should not be left a moment alone;* all window-shutters should be properly fastened, and the room should be stripped of unnecessary furniture and especially pictures. When the patient is able to leave her bed a floor should be devoted, if possible, to her accommodation, one room being reserved for day use and the other for sleeping. It is always advisable to have a sufficient number of nurses to avoid fatiguing struggles, and instruments of restraint should not be made use of except in very rare instances. Where the mania, however, follows exhausting hemorrhage, and where the heart's action is irritable and weak, it is, of course, preferable to keep the patient in a recumbent position, which may be done by a combination camisole or a strong sheet properly fastened at the sides and foot of the bed. Some sort of mechanical restraint is permissible in destructive cases, and is not nearly so exhausting or trying as the injury that is unavoidably done by even the most humane nurses in their efforts to control the patient.

One of the first forms of medicinal treatment consists in the correction, if possible, of the intestinal condition as well as that of the uterus and vagina. Observers generally call attention to the necessity of the removal of sources of peripheral irritation or local infection. An inconsiderable focus of septic infection may give rise to an elevation of temperature, and is often associated with ill-smelling discharge and some tenderness; it is hardly necessary to say that all retained septic material should be carefully removed, either by the curette or some other means, and the mucous membrane of the uterus and vagina should be disinfected. It is always well to give the patient a full dose of calomel and soda, which is to be followed up by such intestinal antiseptics as the salicylate of soda or naphthalin, and the lower bowel as well as the vagina and uterus should be douched with solutions of borax, carbolic acid, or the hypochlorite of sodium.

These douches should be given frequently, and large amounts of liquid are to be employed; at the same time the perineum and external organs of generation are to be washed frequently with antiseptic solutions, and proper precautions are to be taken when the bowels are moved. In some instances the use of dilute hydrochloric acid and nux vomica is of benefit, and at a later stage, when it is possible, lavage is suggested. In some patients the condition of exhaustion and depression is very great, and the administration of strychnine, either hypodermically or by the mouth, is attended with the best results. Of course, one of the earliest indications is the provision of remedies to promote sleep and to calm the excitement which is so pronounced. Our knowledge of the value of intestinal antiseptics leads us to expect most happy effects from the internal use of naphthalin, and MacPherson found that many of his most excited patients became calm and slept well after a few doses of naphthalin, which may be administered in quantities of five grains three times a day, and, if necessary, be increased to fifteen or twenty grains at a dose; should a special hypnotic be needed, there is none better than the hydrobromate of hyoscin, which may be given in doses of from $\frac{1}{100}$ to $\frac{1}{25}$ of a grain, to be repeated, if necessary, until the physiological effects are attained. Should this not succeed, the only other remedy worthy of much confidence is morphine, though chloral, the bromides, chloralamide, or paraldehyde may be tried. While chloral in light cases is better than the last two drugs mentioned, it should never be given to debilitated patients, and where the proportion of blood-corpuscles and the percentage of hæmoglobin are low, it, as well as the bromides, is contraindicated. In such examples it is much better to prescribe some such drug as paraldehyde or chloralamide. The writer does not recommend sulphonal, trional, or others of the series, which sometimes produce surprisingly bad after-effects. In some restless cases where there is much debility, sleep may be produced by large doses of the tincture of digitalis or by alcohol. Hydrotherapy is of decided advantage as an adjunct, and a hot bath or a cold pack will often succeed where drugs fail. As has been said, the feature of puerperal insanity is physical exhaustion and malnutrition. It is, of course, necessary to put the patient upon a simple nutritious diet, which should consist for a long time of nothing but milk in generous quantities, and in the early history of the case it is not wise to give eggs or meat or substances which are apt to be imperfectly digested in the intestines. Iron, arsenic, or the gelatinous preparation of the phosphate of lime made by Leroy, of Paris, may be used at a later stage, with the effect of shortening convalescence.

So far as mental management is concerned, it is best not to resort to any systematic or aggressive measures, the patient being simply protected and furnished with congenial amusement, including free exercise in the open air.

CHAPTER XXVII.

PUERPERAL INFECTION.

By the term puerperal infection we understand the various morbid conditions of the female genital tract and the systemic affections dependent thereon which result from infection during labor or the puerperium by various micro-organisms. These infections are generally designated as puerperal fever, but we prefer to avoid the term, as it still suggests to many the old idea of the essentiality of the affection, which was so strongly urged in this country by the late Fordyce Barker.[1] It also emphasizes the febrile phenomena of the affection, instead of laying stress upon its infectious nature and the consequent responsibility of the obstetrician and his assistants. We also prefer the term puerperal infection to that of puerperal septicæmia, or sepsis, which has lately come into frequent use; for in many instances the infection results in perfectly localized inflammatory processes to which these terms cannot be applied without violating the established rules of diction.

It is probable that puerperal infection has occurred almost as long as children have been born, and passages may be found in the works of Hippocrates, Galen, Avicenna, and many other of the older writers which clearly referred to it. The term puerperal fever, however, is of comparatively recent origin, and was introduced by Willis in 1676, who referred to it as "febris puerperarum." The English term puerperal fever, it appears, was first employed by Strother[2] in 1718, and has continued in use ever since.

The ancients regarded the affection as the result of retention of the lochia; and this remained the prevalent explanation for its occurrence until a comparatively recent date. It was not until the early part of the seventeenth century that other explanations were offered, when Plater showed that it was essentially a metritis, and was followed in the next century by Puzos with his milk metastasis theory.

From the time of Plater until Semmelweiss[3] (1847) demonstrated its identity with wound infection, or, we may say, until Lister demonstrated the value of antiseptic surgery, all sorts of theories were suggested concerning its origin and nature, the consideration of which would occupy the entire space allotted to us. And we would, therefore, refer those who are interested in the history of the affection to the monographs of Eisenmann (*Wund und Kindbettfieber*, Erlangen, 1837) and Silberschmidt (*Historische-kritische Darstellung der Pathologie des Kindbettfiebers, Gekrönte Preisschrift*, Erlangen, 1859, 131 pp.).

Organisms Causing Puerperal Infection. In 1847, Semmelweiss,[4] then an assistant in the Vienna Lying-in Hospital, began to study the cause of the frightful mortality attending the confinement of women in that hospital, as compared with the small number of women succumbing to puerperal infection when delivered in their own homes. As a result of his observations, he concluded that puerperal infection was a wound-infection, and was due to the introduction of septic material by the examining finger. He accordingly obliged every one to disinfect his hands with chlorine water before examining the parturient woman, and had the pleasure of seeing the mortality fall from 10 per cent. or more to about 1 per cent. In spite of the excellent results, his work was scoffed at by many of the most prominent men of his time; and it was not until after the discoveries of Lister and the development of bacteriology that his services were thoroughly appreciated. Trousseau,[1] in 1858, recognized the same fact, and pointed out the identity of puerperal and wound infection in the following words: "Quelque chose de spécifique s'ajouté à la plaie placentaire, à la plaie chirurgicale."

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[1] Barker. The Puerperal Diseases, third edition, 1874.

[2] Strother. Critical Essay on Fevers. London, 1718.

[3] Semmelweiss. Die Aetiologie, der Begriff u. die Prophylaxis des Kindbettfiebers Pest. Wien u. Leipzig, 1861.

[4] Semmelweiss. Op. cit.

We shall now briefly consider the organisms which have been proved to be causes of puerperal fever.

(*a*) STREPTOCOCCUS. It has been abundantly and conclusively demonstrated by many excellent observers that the streptococcus is the usual cause of the epidemic and fatal forms of puerperal infection. Before the development of cultural methods streptococci were demonstrated by many observers in the tissues of women dead of puerperal infection. They were first observed in 1865 by Mayerhofer,[2] whose findings were confirmed by Coze and Feltz,[3] Recklinghausen,[4] Waldeyer,[5] Klebs,[6] Orth,[7] Heiberg,[8] and Landau.[9] To Pasteur[10] (1880) belongs the credit of having first cultivated streptococci from cases of puerperal infection, when he designated them as "chapélets en grains." He was assisted in this work by Doléris,[11] who carried it on still further and was able to demonstrate that streptococci were the usual infectious agents, but that staphylococci, and in rare cases bacilli as well, played a part in the production of the infection. The researches of Pasteur and Doléris were soon confirmed by Fraenkel,[12] Iovanovic,[13] Lomer,[14] Winckel,[15] Bumm,[16] Doederlein,[17] Winter,[18] Ott,[19] Czerniewski,[20] Widal,[21] and all subsequent observers; so that at the present time it is universally admitted that the streptococcus pyogenes is the direct causative agent in most severe cases of puerperal infection.

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[1] Trousseau. Quoted by Doléris. See note 11.

[2] Mayerhofer. Zur Frage nach der Aetiologie der Puerperalprocesse. Monatsschrift f. Geburtskunde, 1865, xv. 112.

[3] Coze and Feltz. Gazette med de Strassburg, 1869, p. 30.

[4] Recklinghausen. Cent. f. med. Wissenschaften, 1871, 713.

[5] Waldeyer. Ueber das Vorkommen von Bakterien bei der diphtherischen Form des Puerperalfiebers. Arch. f. Gyn., 1872, iii. 293.

[6] Klebs. Archiv f. exper. Path., Bd. v. p. 417.

[7] Orth. Virchow's Archiv, lviii. 441.

[8] Heiberg. Die puerperalen und pyämischen Processe, 1873.

[9] Landau. Ueber puerperalen Erkrankungen. Arch. f. Gyn., 1874, vi. 147.

[10] Pasteur. Septicémie puérpérale. Bull. de l'Acad. de Méd., 1879, 260, 271.

[11] Doléris. Essai sur la pathogénie et la thérapeutique des accidents infectieux des suites de couches. Thèse de Paris, 1880.

[12] Fraenkel. Quoted by Lomer. See below.

[13] Iovanovic. Quoted by Lomer. See below.

[14] Lomer. Ueber den heutigen Stand der Lehre von der Infectionträgern bei Puerperalfieber. Zeit. f. Geb. u. Gyn., 1884, x. 366.

[15] Winckel. Zur Lehr von dem internen puerperalen Erysipel. Verh. d. deutschen Ges. f. Gyn., 1886, 78.

[16] Bumm. Die puerperale Wundinfektion. Cent. f. Bakteriol., 1887, ii. 343.

[17] Doederlein. Untersuchung über das Vorkommen von Spaltpilzen in den Lochien des Uterus und der Vagina gesunder und kranker Wöchnerrinnen. Arch. f. Gyn., 1887, xxxi. 412.

[18] Winter. Die Mikroörganismen in Genitalkanal der gesunden Fraun. Zeit. f. Geb. u. Gyn., 1888, xiv. 443.

[19] Ott. Zur Bakteriologie der Lochen. Arch. f. Gyn., 1888, xxxii. 436.

[20] Czerniewski. Zur Frage von den puerperalen Erkrankungen. Eine bakteriologische Studie. Arch. f. Gyn., 1888, xxxiii. 73.

[21] Widal. Étude sur l'infection puérpérale. Thèse de Paris, 1889. Infection puérpérale et phlegmatia alba dolens. Gaz. des hôp., 1889, 565.

(*b*) STAPHYLOCOCCUS. While streptococci are usually the causative agents in puerperal infection, it has gradually been demonstrated that they are not necessarily the only organisms which may be concerned in its production, and it has been clearly shown that most of the pus-producing organisms which may be concerned in wound-infection may, likewise, occasionally give rise to puerperal infection.

Brieger,[1] in 1888, was the first to demonstrate that puerperal infection might be due to staphylococci, when he reported autopsies upon seven cases, in five of which he was able to demonstrate the staphylococcus aureus. Doléris,[2] in his thesis of 1880, stated that he was able to cultivate in pure culture a coccus which was arranged in groups or bunches, but it was not until 1894[3] that he stated definitely that they were staphylococci. The observations of Brieger[4] were soon confirmed by other observers, among whom may be mentioned Czerniewski,[5] Fehling,[6] Haegler,[7] Doederlein,[8] Widal,[9] Mironow,[10] Netter and Bonnaire,[11] Sabrazès and Faquet,[12] Krönig,[13] and Strünckman.[14]

It was stated by Fehling[15] and Haegler[16] that staphylococci usually give rise to mild forms of infection. But this is not borne out by the observations of other authors. Occasionally mixed infections with the staphylococcus and streptococcus are observed, as reported by Doederlein[17] and Bar and Tissier.[18] It appears that the staphylococcus aureus is the variety observed in puerperal infection, while the albus and citreus play little or no part in its production.

(*c*) GONOCOCCUS. It has long been believed by clinicians that gonorrhœa not infrequently plays a part in the production of puerperal infection. But it was not until 1893 that Krönig[19] adduced bacteriological proof of its action. He then reported nine cases of mild infection, in all of which he was able to obtain pure cultures of gonococci from the uterine lochia. In a recent communication[20] he states that he was able to cultivate the gonococcus in 50 out of 179 cases presenting febrile puerperia, and has thus shown that it plays an important part in the production of puerperal disease. None of these cases resulted in death, and the great majority recovered spontaneously.

[1] Brieger. Ueber bakteriologische Untersuchungen bei einigen Fällen von Puerperalfieber. Charité Annalen. 1888, xiii. 198.

[2] Doléris. Essai sur la pathogénie et la thérapeutique des accidents infectieux des suites de couches. Thèse de Paris, 1880.

[3] Doléris. Inflammation puérpérale. Nouve. Archives d'obst. et de gyn., 1894, ix. 97-122, 142-161.

[4] Brieger. Ueber bakteriologische Untersuchungen bei einigen Fällen von Puerperalfieber. Charité Annalen, 1888, xiii 198.

[5] Czerniewski. Zur Frage von den puerperalen Erkrankungen. Eine bakteriologische Studie Arch. f. Gyn., 1888, xxxiii. 73.

[6] Fehling. Ueber Selbstinfektion. Verhand. deutsche Ges. f. Gyn., 1889, Freiburg

[7] Haegler. Quoted by Fehling. Physiologie und Path. des Wochenbetts. Stuttgart, 1890.

[8] Doederlein. Klinisches und Bakteriologisches über eine Puerperalfieber-epidemie. Arch. f. Gyn., 1891. xl. 99.

[9] Widal. Étude sur l'infection puérpérale. Thèse de Paris, 1889. Infection puérpérale et phlegmatia alba dolens. Gaz. des hôp., 1889, 565.

[10] Mironow. Ueber die Ursachen der puerperalen Erkrankungen. D. I. Charkow, 1889. Referat. Cent. f. Gyn., 1891, 678-80.

[11] Netter and Bonnaire. Quoted by Doléris, No. 36.

[12] Sabrazès and Faquet. Infection puérpérale staphylococcique, etc. Gaz. des hôp., 1894, 1039-41.

[13] Krönig. Aetiologie und Therapie der puerperalen Endometritis. Cent. f. Gyn., 1895, 422-32. Discussion über Endometritis. Verh. d. deutschen Ges. f. Gyn., 1895, 498-502.

[14] Strünckmann. Zur Bacteriologie der Puerperal-infection. Berlin, 1898.

[15] Fehling. Ueber Selbstinfektion. Verhand. deutsche Ges. f. Gyn., 1889, Freiburg.

[16] Haegler. Quoted by Fehling. Physiologie und Path. des Wochenbetts. Stuttgart, 1890.

[17] Doederlein. Klinisches und Bakteriologisches über eine Puerperalfieber-epidemie. Arch. f. Gyn., 1891, xl. 99.

[18] Bar and Tissier. La Semaine méd., 1896, 155. Sérothérapie dans l'infection puérpérale. L'Obstétrique, 1896, 97-128 and 201-217.

[19] Krönig. Vorläufige Mittheilung über Gonorrhœa im Wochenbett. Cent. f. Gyn., 1893, 157.

[20] Krönig. Aetiologie und Therapie der puerperalen Endometritis. Cent. f. Gyn., 1895, 422-32. Discussion über Endometritis. Ver. d. deutschen Ges. f. Gyn., 1895, 498-502.

Leopold[1] also reports similar cases, and Maslowsky[2] and Neumann,[3] in two recent articles, state that they were able to demonstrate the gonococcus in the tissues in cases of endometritis deciduæ. It is generally believed that gonorrhœal infection in the puerperium pursues a favorable course. But in very rare instances a gonorrhœal septicæmia may result, which will lead to the death of the patient, as in a case recently reported by Harris and Dabney.[4]

(*d*) BACILLUS COLI COMMUNIS. In the writer's article[5] upon puerperal infection from a bacteriological point of view (1893), it was stated that von Franque[6] had cultivated the colon bacillus from a case of puerperal infection, and the belief was expressed that it would be demonstrated more frequently in the future. Subsequent work has amply fulfilled this prediction, and we can now point to a long series of cases due to this organism. *A priori*, this is what should be expected when we consider the proximity of the genital tract to the rectum and the ease with which contamination may occur when the obstetrician infringes the strict rules of asepsis.

Some idea of the abundance of the colon bacillus may be gained by the consideration of the figures of several French observers; thus, Vignal[7] states that one decigramme of feces contains about twenty millions of colon bacilli; and Gilbert and Dominici[8] estimate that from twelve to fifteen billions are daily excreted with the feces. It thus becomes apparent that the examining finger cannot avoid contamination with these organisms if it comes in contact with a non-disinfected perineum.

Infection with the colon bacillus has been observed by Mironow,[9] Ahlfeld,[10] Eisenhardt,[11] Demélin,[12] Parmentier,[13] Gebhard,[14] Chantemesse[15] and Widal, Marmorek,[16] Charpentier,[17] Krönig,[18] Bar and Tissier,[19] and myself in many cases.

Gebhard[20] demonstrated its presence in seven cases of tympania uteri, either alone or in combination with other organisms; and Galtier[1] states that it is the organism most frequently concerned in its production.

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[1] Leopold. Ueber gonorrhoisches Fieber in Wochenbett bei einer innerlich nicht untersuchten Gebärenden. Cent. f. Gyn., 1893, 675.

[2] Maslowsky. Zur Aetiologie der vorzeitigen Ablösung der Placenta vom normalen Sitz. Monats. f. Geb. u. Gyn., 1896, iv. 212–218.

[3] Neumann. Ueber puerperalen Uterusgonorrhœa. Monats. f. Geb. u. Gyn., 1896, iv. 109–116.

[4] Harris and Dabney. Report upon a Case of Gonorrhœal Endocarditis in a Patient dying in the Puerperium. Bull. Johns Hopkins Hospital, 1901, xii. 68–76.

[5] Williams. Puerperal Infection Considered from a Bacteriological Point of View, with Special Reference to the Question of Auto-infection. Amer. Journ. Med. Sci., July, 1893.

[6] v. Franque. Bacteriologische Untersuchungen bei normalen und fieberhaftem. Wochenbett Zeit. f. Geb. u. Gyn., 1893, xxv. 277.

[7] Vignal. Sur l'action des micro-organisms de la bouche et des matières fécales. Comptes-rend. de la Soc. de Biol., Août., 1887.

[8] Gilbert and Dominici. Recherches sur le nombre des microbes du tube digestif. Semaine méd., 1894, p. 76.

[9] Mironow. Ueber die Ursachen der puerperalen Erkrankungen. D. I. Charkow, 1889. Referat. Cent. f. Gyn., 1891. 678–80.

[10] Ahlfeld. Beiträge zur Lehre vom Resorptionsfieber in der Geburt und im Wochenbette und von der Selbstinfektion. Zeit. f. Geb. u. Gyn., 1893, xxvii. 466–519.

[11] Eisenhardt. Puerperale Infektion mit tödlichen Ausgang verussacht durch Bakterium coli commune. Arch. f. Gyn., 1894, xlvii. 189–202.

[12] Demélin. Quoted by Barbier. Des pseudo-infections puérpérales d'origine intestinale. Thèse de Paris, 1894.

[13] Parmentier. Quoted by Barbier. Des pseudo-infections puérpérales d'origine intestinale. Thèse de Paris, 1894.

[14] Gebhard. Bacterium coli commune aus Fällen von Tympania uteri gezüchtet. Verh. deutsche Ges. f. Gyn., 1893, 305.

[15] Chantemesse. Bulletin méd., 1891, p. 1139.

[16] Marmorek. Le streptocoque et le sérum antistreptococcique. Annales de l'Inst. Pasteur, 1895, ix. 593–620.

[17] Charpentier. Sérothérapie antistreptococcique appliqué au traitement de la fièvre puérpérale. La Semaine gyn., 1896, 89–92, No. 12.

[18] Krönig. Ueber Fieber intra-partum. Cent. f. Gyn., 1894, 749.

[19] Barr and Tissier. La Semaine méd., 1896, 155. Sérothérapie dans l'infection puérpérale. L'Obstétrique, 1896, 97–128 and 204–217.

[20] Gebhard. Bacterium coli commune aus Fällen von Tympania uteri gezüchtet. Verh. deutsche Ges. f. Gyn., 1893, 305.

In not a few cases it is associated with the streptococcus, as has been observed by Marmorek,[2] Charpentier,[3] Bar and Tissier,[4] and the writer the former observers stating that the combination appears to augment the virulence of the streptococcus and gives rise to very intense affections. Whether the future will demonstrate the accuracy of their statements remains to be seen.

(*e*) BACILLUS DIPHTHERIÆ. Until very recently it was believed that the "diphtheritic deposits" upon the vagina and the interior of the puerperal uterus were due to the streptococcus alone, and had nothing to do with true diphtheria. But the recent observations of Nisot,[5] Bumm,[6] and the writer[7] show that this is not always the case, for we reported cases in which we were able to cultivate the Klebs-Loeffler bacillus from the diphtheritic membrane in the vagina and to cure the affection by the use of the anti-diphtheritic serum.

(*f*) PNEUMOCOCCUS. Cases have been reported by Weichselbaum,[8] Czemetschka,[9] Schuhl,[10] and Vesque,[11] in which the micrococcus lanceolatus has been demonstrated in the puerperal uterus. In the case reported by the former the genital infection was the primary lesion, while in the latter case it was the result of systemic infection. And Bar and Tissier[12] have lately reported a case of sepsis in which it was associated with the streptococcus.

(*g*) THE BACILLUS AËROGENES CAPSULATUS (GAS BACILLUS). As our knowledge concerning the gas bacillus of Welch has become more accurate, it has been shown that it may also occasionally be concerned in puerperal infection. In 1896 the writer observed a case in which its presence was demonstrated, and which was described by Dr. Dobbin in the *Bulletin of the Johns Hopkins Hospital.* Briefly stated, the case was as follows: The aid of the out-patient obstetric department of the Johns Hopkins Hospital was solicited in the case of a Bohemian woman with a generally contracted pelvis, who had been in labor for some three to four days under the care of a midwife. When the writer saw the patient he found the head of a macerated child firmly engaged in the superior strait, with the uterus tetanically contracted. A fetid dark-colored discharge, which contained many gas bubbles, was escaping from the vagina with a crackling sound. Owing to the softened condition of the child's head, several futile attempts at delivery were made, and we were finally forced to deliver it with Tarnier's basiotribe. The mother was profoundly infected at the time of delivery, and died the next day. A few hours after death the body rapidly became intensely swollen by the development of gas in the subcutaneous tissues, and soon nearly doubled its original size. The same changes were observed in the fœtus and in the placenta, and we were able to demonstrate the presence of the gas bacillus in the fœtal and placental tissues, as well as in the uterine lochia. Unfortunately, no autopsy was allowed upon the mother, and we were, therefore, unable to say to what extent the organisms had penetrated into her tissues.

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[1] Galtier. De l'infection primitive du liquide amniotique après la rupture prematurée des membranes de l'œuf humain. Thèse de Paris, 1895.

[2] Marmorek. Le streptocoque et le sérum antistreptococcique. Annales de l'Inst. Pasteur, 1895, ix. 593–620.

[3] Charpentier. Sérothérapie anti-streptococcique appliqué au traitement de la fièvre puérpérale. La Semaine gyn., 1896, 89–92, No. 12.

[4] Bar and Tissier. La Semaine méd , 1896, 155. Sérotherapie dans l'infection puérpérale. L'Obstétrique, 1896, 97–128 and 204–217.

[5] Nisot. Diphthérie vagino-utérine puérpérale. Sérothérapie guérison. Annales de Gyn., 1896, xlv. 259.

[6] Bumm. Ueber Diphtherie und Kindbettfieber. Zeit. f. Geb. u. Gyn . 1895, xxxiii. 126-136.

[7] Williams. Puerperal Diphtheria. American Journal of Obstetrics, August, 1898.

[8] Weichselbaum. Wien. klin. Wochen., 1888, No. 28.

[9] Czemetschka. Zur Kenntniss der Pathogenese des puerperalen Infektion (Metrolymphangitis post partum) als Metastase anderweitiger durch Diplococcen bedingter Erkrankungen. Prager med. Wochen., 1894, xix. 233.

[10] Schuhl. Une epidémie d'infection puérpérale à pneumocoques. Presse méd., Aug. 21, 1897.

[11] Vesque. Des infections puérpérales non-streptococciques. Thèse de Nancy, 1899.

[12] Bar and Tissier. Sérothérapie dans l'infection puérpérale. L'Obstétrique, 1896, 97–128 and 204–217.

Well-authenticated cases of infection with this organism have been reported by Stewart,[1] Ernst,[2] Norris,[3] Woods,[4] Halban,[5] and others, and the entire literature upon the subject was exhaustively reviewed by Welch[6] in 1900.

Cases have also been reported by Krönig,[7] Doléris,[8] Lindenthal,[9] and others, which were probably due to the same organism.

It is important to remember that the gas-bubbles which are found in the blood-vessels of women, who were supposed to have perished from the entrance of air into the uterine sinuses, are not infrequently the product of the bacillus in question. Attention was first directed to this point by Dobbin,[10] and was still further insisted upon by Welch,[11] so that at present we do not consider that one is justified in making the diagnosis of air-embolism, unless careful bacteriological examination has demonstrated the absence of the gas bacillus.

(*h*) Bacillus Typhosus. In 1898 Dobbin[12] and the writer[13] isolated the typhoid bacillus, streptococcus, staphylococcus aureus, and an unidentified anaërobic gas-producing bacillus from the uterine lochia of a woman who was admitted to the Johns Hopkins Hospital on the fifth day of the puerperium, with high fever. Her blood possessed the characteristic Widal reaction, but all the usual symptoms of typhoid fever were absent. The temperature fell to normal on the thirteenth day, and did not rise again. We are inclined to believe that the typhoid bacilli were introduced into her uterus by the midwife, along with other organisms, opportunity being afforded by the fact that she was delivered upon the same bed upon which her husband had died of typhoid fever a few days previously. And as they were ignorant Bohemians, it is quite conceivable how an infection may have occurred.

A somewhat similar case has been reported by Blumer,[14] in which the autopsy revealed an unsuspected typhoid fever.

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[1] Stewart and Baldwin. Bacillus aërogenes capsulatus. Columbus Med. Journ., Aug., 1893.

[2] Ernst. Ueber einen gasbildenden Anaeroben in menschlichen Körperund seine Beziehung zur Schaumleber. Virchow's Arch., cxxxiii, Heft 2.

[3] Norris. A Report of Six Cases in which the Bacillus aërogenes capsulatus was Isolated. Amer. Journ. Med. Sci., Feb., 1899.

[4] Wood. Puerperal Infection Caused by the Bacillus aërogenes capsulatus. Med. Record, April 15, 1899. Ref. Cent. f. Gyn., 1900, p. 436, No. 16.

[5] Halban. Uterus emphysem und gas-sepsis. Monatsschr. f. Geb. u. Gyn., 1900, xi 88-122.

[6] Welch. Boston Med. Jour., 1900.

[7] Krönig. Discussion über Endometritis. Verh. d. deutschen Ges. f. Gyn., 1895, 498-502.

[8] Doléris. Inflammation puérpérale. Nouv. Arch. d'obstét. et de gyn., 1894, ix. 97-122, 142-162.

[9] Lindenthal. Beiträge zur Aetiologie der Tympania uteri. Monatsschr. f. Geb. u. Gyn., 1898, vii, 269-86.

[10] Dobbin. Puerperal Sepsis due to Infection with the Bacillus aërogenes capsulatus. Bull. Johns Hopkins Hosp., Feb. 1, 1897.

[11] Loc. cit.

[12] Dobbin. A Case of Puerperal Infection in which the Bacillus typhosus was Found in the Uterus. Amer. Journ. Obst., 1898, xxxviii, 185-198.

[13] Williams. Ein Fall von puerperaler Infection, bei dem sich Typhus-bacillen in den Lochien fanden. Centralbl. f. Gyn., 1898, No. 34.

[14] Blumer. A Case of Mixed Puerperal and Typhoid Infection, in which the Streptococcus and Typhoid Bacilli were Isolated both from the Blood and the Uterine Cavity. Amer. Journ. Obst., 1899, xxxix. 42-50.

(*i*) BACILLARY SEPSIS. Isolated cases reported by Fraenkel,[1] Doléris,[2] Widal,[3] Mixius,[4] Goldscheider,[5] and others tend to show that certain cases of fatal infection may be due to bacilli with whose properties we are as yet unacquainted. But the bacteriological work upon which these statements are based is not of a character to enable us to be at all sure about the organisms in question, much less to classify them. At the same time, bacteriological examination of the uterine lochia in all cases of fever in the puerperium, as carried out by Krönig[6] and the writer, clearly show that many bacteria, with which we are as yet unfamiliar, may take part in the process.

(*j*) SAPRÆMIA. Beside the cases in which the infection is due to the growth and extension of micro-organisms within the body, there is a large class of cases in which the symptoms are due to the absorption of toxic products produced by organisms within the uterus or elsewhere in the generative tract which do not make their way into the blood-current. To this form of infection Matthews Duncan, some years ago, applied the term "sapræmia," which has continued in use ever since. It is usually thought to be due to the invasion of the uterus by putrefactive organisms, with whose properties we are as yet almost totally unfamiliar.

There is no doubt that the term has been greatly abused, and that many cases have been included under it which really were due to infection with the ordinary pyogenic organisms, and at the present time we are hardly justified in considering a case as sapræmic unless the lochia have been examined bacteriologically and found to be free from pyogenic organisms.

This statement is borne out by the observations of Bumm,[7] who found streptococci in eight out of eleven cases which were clinically designated as sapræmia. Von Franque[8] was, likewise, able to cultivate streptococci in pure culture from a case which exhibited the clinical picture of sapræmia, and as the result of his observations stated that "sapræmic fever in the puerperium is extremely rare, and it should only be diagnosed when an accurate biological examination of the uterine lochia has demonstrated the absence of pathogenic and the presence of saprophytic organisms."

The organisms entering into the causation of sapræmia are mostly of an anaërobic nature, and, therefore, cannot be cultivated in the usual culture media. Many of them are gas producers, and thus cause the frothy, ill-smelling secretion which is so characteristic of these cases. There is certainly a great variety of organisms which may be concerned in the production of sapræmia, though only a few have as yet been isolated. Thus, Bumm[9] was able to cultivate from a case an anaërobic bacillus, which decomposed albumin and produced poisonous substances; and Doederlein,[1] in another case presenting a frothy, purulent secretion, was able to isolate an anaërobic gas-producing coccus. Kronig[2] in 43 abnormal puerperia found organisms which did not grow on the usual media, and in 32 of them obtained organisms which only grew anaërobically.

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[1] Fraenkel. Quoted by Lomer. See below.

[2] Doléris. Inflammation puérpérale. Nouv. Archiv. d'obstét. et de gyn., 1894, ix. 97-122, 142-161.

[3] Widal. Étude sur l'infection puérpérale. Thèse de Paris, 1889.

[4] Mixius. Bakteriologische Untersuchungen eininger Falle puerperaler Sepsis. D. I., Berlin, 1892.

[5] Goldscheider. Klinische und bakteriol. Mittheilungen über Sepsis puérpéralis. Charité Annalen, 1893, xviii. 164-242.

[6] Krönig. Bakteriologie des Genital-kanales der schwangeren, kreisenden und puerperalen Frau. Leipzig, 1897.

[7] Bumm. Histologische Untersuchungen über die puerperale Endometritis. Arch. f. Gyn., 1891, xl. 398.

[8] v. Franque. Bakteriologische Untersuchungen bei normalem und fieberhaftem. Wochenbett. Zeit. f. Geb. u. Gyn., 1893, xxv. 277.

[9] Bumm. Ueber die Aufgaben weiterer Forschungen auf dem Gebiete der puerperalen Wundinfektion. Arch. f. Gyn., 1889, xxxiv. 325.

Beside the organisms which we have mentioned, it is not unlikely that further research will show still other organisms which may play a part in the production of isolated cases of infection; but from what we have already said, it is perfectly clear that the organisms usually concerned are the well-known pyogenic organisms (streptococcus, staphylococcus, colon bacillus, and gonococcus) and the various putrefactive organisms.

Some idea of the frequency with which the different organisms are concerned in the production of the puerperal infections may be gained by recurring to the work of Krönig,[3] who examined 179 cases of puerperal endometritis bacteriologically, and, as a result of his observations, divided them into three groups, namely, pyogenic, gonorrhœal, and sapræmic. The pyogenic group comprised 79 cases, in 75 of which the infective agent was the streptococcus, and in 4 the staphylococcus. In 50 cases he was able to demonstrate the presence of the gonococcus, and in 43 of the 50 sapræmic cases he was able to demonstrate organisms which did not grow on the usual culture media, 32 of which were anaërobic.

The writer has examined the uterine lochia bacteriologically in 150 cases in which the temperature rose to 101° F. or higher during the first ten days of the puerperium, and found

Streptococci	31 cases.
Streptococci and colon bacilli	5 "
Streptococci, staphylococci, and bacilli	2 "
Streptococci, colon and gas bacilli	2 "
Streptococci, staphylococci, gas and typhoid bacilli	1 case.
Streptococci, staphylococci, colon and gas bacilli	1 "
Streptococci and unidentified bacilli	2 cases.
Staphylococci	4 "
Colon bacilli	11 "
Gonococci	7 "
Gonococci and colon bacillus	1 case.
Unidentified aërobic bacteria	4 cases.
Unidentified anaërobic bacteria	8 "
Diphtheria bacillus	1 case.
Typhoid bacillus	1 "
Bacteria seen in cover-slips, but which would not grow in any media	45 cases.
Absolutely sterile	25 "

Pathological Anatomy. After having thus considered more or less in detail the organisms which play a part in the production of puerperal infection, we now turn to the consideration of the lesions produced by them.

The lesions may vary very greatly in a given case; and it is probably for this reason that the older authors did not earlier appreciate the true nature of the affection. The lesions may vary from a coated perineal tear to an inflammatory process involving the entire generative tract, and in many cases extending beyond it to the parametrium or peritoneum, and sometimes resulting in a general pyæmic infection. In other cases the infectious elements pass through the port of entry with such rapidity that they do not there give rise to local lesions, but produce a septicæmia, which is rapidly fatal. The most fatal forms of puerperal septicæmia end with extreme rapidity, and have been well designated by the French as "sepsis foudroyante." In most cases of puerperal infection, however, the endometrium is the portion affected, and in the majority of cases the disease remains limited to it, and is designated as septic or putrid endometritis, according as it is the result of the invasion of pyogenic or putrefactive organisms.

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[1] Doederlein. Vorläufige Mittheilung über weitere bakteriologische Untersuchungen des Scheidensekretes. Cent. f. Gyn., 1894, 779.

[2] Krönig. Aetiologie und Therapie der puerperalen Endometritis. Cent. f. Gyn., 1895, 422-432. Discussion über Endometritis. Verh. d. deutschen Ges. f. Gyn., 1895, 498-502.

[3] Krönig. Op. cit.

In puerperal infection any portion of the generative tract may be the seat of the lesion, and in many cases more than one portion is involved, and we accordingly have to consider puerperal vaginitis, endometritis, metritis, parametritis, metro-lymphangitis, metro-phlebitis, salpingitis, oöphoritis, peritonitis, pyæmia, and phlegmasia alba dolens.

PUERPERAL ULCER. We shall now take up the consideration of the various lesions more in detail, and first turn our attention to those occurring about the *vulva and vagina*. In the pre-antiseptic period the puerperal ulcer was of very frequent occurrence; but with the introduction of aseptic methods into midwifery its frequency has become markedly diminished, so that now it occurs but rarely.

These ulcers appear on the surface of the tears about the vulva and perineum, and soon take on a dirty, greenish-yellow appearance, which is due to necrosis, and are bathed by a dirty purulent secretion.

In some cases the ulcers take on a markedly diphtheritic appearance, and were formerly designated as "diphtheritic ulcers"; but careful histological examination has shown that they have nothing in common with diphtheria except their external appearance.

As a rule, the puerperal ulcers about the vulva give rise to very little systemic disturbance, and would frequently pass unnoticed were it not for ocular inspection.

PUERPERAL VAGINITIS may occur in two forms: either as a diffuse, general inflammation, when the mucosa becomes thickened, soft, and reddened, and bathed with an abundant purulent secretion. While in other cases, and especially when torn surfaces are present, a larger or smaller portion of the vagina may be covered by a pseudo-diphtheritic membrane. This membrane may vary in extent from a small patch covering a slight tear to a complete cast of the entire vaginal canal.

Until recently it was believed that none of the so-called cases of diphtheria of the vagina were due to the invasion of the bacillus diphtheriæ. But the recent observations of Bumm,[1] Nisot,[2] and the writer[3] show that in rare instances we may have to deal with true diphtheria of the vagina caused by the Loeffler bacillus.

ENDOMETRITIS. The most usual lesion in puerperal infection is an inflammation of the lining membrane of the uterus. When we recall the condition of the uterus immediately post partum, with its bleeding surfaces, its large amount of recently torn tissue, and the large gaping thrombosed placental sinuses, we readily see how organisms which have been introduced into the uterus during labor easily find entry into its tissues. And when we consider the mechanism by which the decidua is normally removed, we readily see that an ideal culture-medium is prepared by nature for the reception and propagation of organisms introduced from without.

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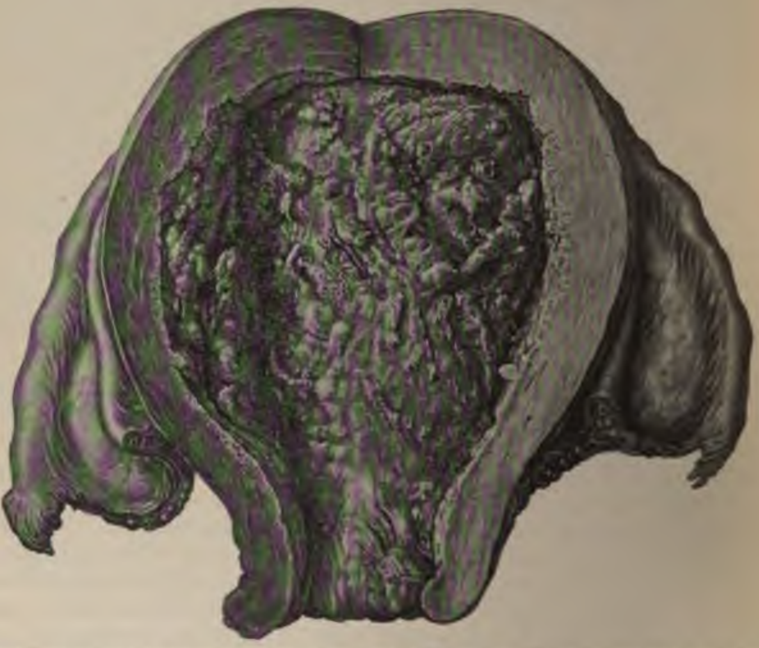
[1] Bumm. Ueber Diphtherie und Kindbettfieber. Zeit. f. Geb. u. Gyn., 1885, xxxiii. 126–136.

[2] Nisot. Diphthérie vagino-utérine puérpérale. Sérothérapie guérison. Annales de Gyn., 1896, xlv. 259.

[3] Williams. Diphtheria of the Vulva. Amer. Journ. Obstet., 1898, xxxviii. 180–185.

In puerperal endometritis the infection may be limited to the placental site, or may extend over the entire mucosa. When the placental site alone is infected, we usually find the organisms growing into the thrombi and producing comparatively little local reaction. But when the entire internal surface of the uterus is affected, the endometrium becomes converted into a stinking, sloughing surface, made up of necrotic material and decidual débris, and bathed with a bloody, purulent discharge. The necrotic material soon takes on a dirty, yellowish-green appearance, and in many instances we find ulcerated surfaces coated with fibrin and presenting the clinical picture of diphtheria. This form of endometritis was formerly designated as diphtheritic, but, as stated when considering the vagina, we have to deal not with a true diphtheria, but simply with a fibrinous exudation, the result of an intense necrosis following the invasion of the usual pyogenic organisms.

FIG. 357.

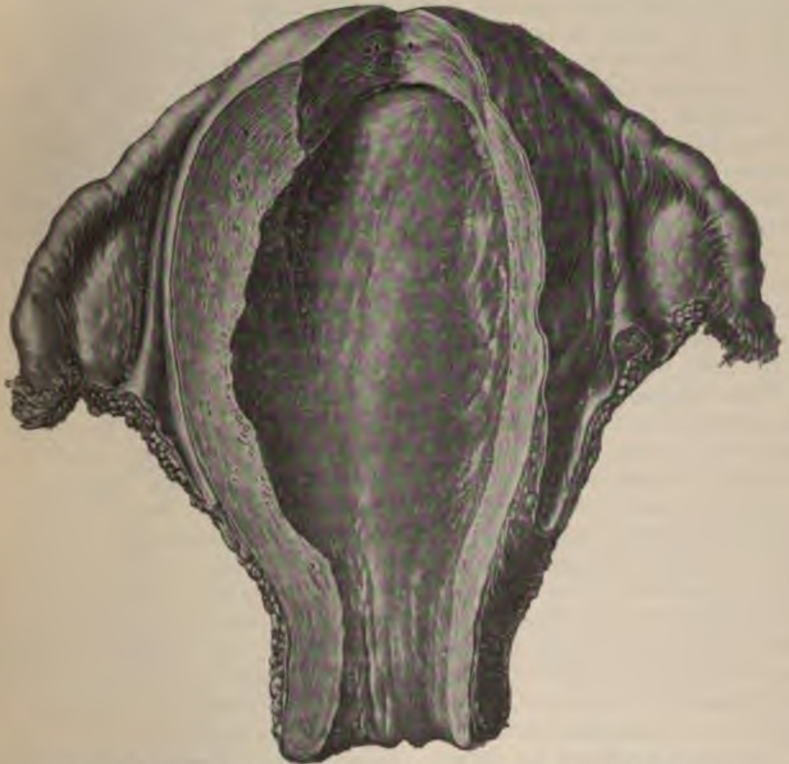


Uterus from patient dying on tenth day from a mixed infection—streptococcus and colon bacilli.

When the infection is due to the streptococcus or staphylococcus, there is usually very little odor accompanying it, but when it is due to invasion by the colon bacillus or any of the various putrefactive organisms, we find the interior of the uterus bathed with a profuse foul-smelling discharge which frequently contains gas bubbles. The amount of necrotic material produced in puerperal endometritis is often very great, and, after curetting, it may recur with great rapidity. Fig. 357 represents the uterus from a case of puerperal infection due to the streptococcus and colon bacillus, in which the woman succumbed ten days after the birth of the child, having been curetted three or four days before death, when it was said the uterus was scraped perfectly clean. A glance at the drawing, however, shows the entire uterine cavity filled with necrotic material, which in all probability was produced in the interval elapsing between the curettage and the time of death.

In most cases the infection remains limited to the endometrium, but in many others it progresses beyond it, giving rise to a metritis, a lymphangitis, or a phlebitis, as the case may be. The extension of the process beyond the endometrium usually occurs through the lymphatics, and we may trace in their course areas of inflammation extending from the endometrium to the peritoneal surface of the uterus. In other cases, and especially where the infection has been limited to the placental site, we find that the thrombi have been invaded by the micro-organism, resulting in a phlebitis which may remain limited to the uterine wall, or may

FIG. 358.



Uterus from patient dying on tenth day from a pure streptococcic infection.

rapidly extend beyond it and give rise to the various thrombotic forms of puerperal infection.

It would appear that the lesions produced in the endometrium vary very considerably according to the micro-organisms concerned, and particularly according to their virulence. In the cases in which we have to deal with a virulent streptococcus or staphylococcus infection, the changes produced in the endometrium are comparatively slight, the process rapidly spreading through the lymphatics or veins past the uterus, and giving rise to a peritonitis or a general systemic infection. Whereas, in the cases due to the putrefactive organisms, and also those due to the colon bacillus and to the ordinary pus-organisms of lesser virulence, the process remains more or less limited to the endometrium and gives rise to marked local lesions. Fig. 358 represents the uterus from a woman dying of a virulent streptococcic infection, and in this it is seen that its interior is almost perfectly smooth, and presents nothing which could have been removed by means of the curette, and stands in marked contrast to the case figured above, in which the infectious agents were the streptococcus and colon bacillus.

When we consider the histology of puerperal endometritis we find that these differences are still further accentuated. Most of our knowledge on this point we owe to the researches of Bumm[1] and Doederlein,[2] both of whom have shown that there is a marked histological difference between putrid and septic endometritis. According to Bumm, in sections through the wall of a uterus the seat of a putrid endometritis we find a thick layer of necrotic material lining the uterine cavity, and imbedded in it large numbers of the offending micro-organisms. Beneath this we find a thick layer of small-cell infiltration, which we may designate as the zone of reaction, and beneath it more or less normal tissue. Careful study of the sections shows us that the micro-organisms are limited almost entirely to the superficial necrotic layer; a few may be found in the reaction zone, but none in the tissues beneath it, thus showing nature's mode of preventing the invasion of the body by the micro-organisms. (See Plates XXXIV. and XXXV.)

These pictures are observed not only in the cases due to infection with the putrefactive organisms, but also in those cases in which the pyogenic organisms possess only a slight degree of virulence. On the other hand, in cases of septic endometritis, and especially where the organisms are virulent, we observe a totally different appearance. Here we likewise find adjoining the uterine cavity a layer of necrotic material, which, however, is usually thinner than in the preceding case. In this we find micro-organisms. The zone of small-cell infiltration is either lacking or very imperfectly developed, and we observe the micro-organisms making their way down through the decidua, and along the lymphatics through the muscular wall of the uterus out to its peritoneal surface. The writer has been able abundantly to confirm the observations of Bumm, and there is no doubt that his conclusions are amply justified.

The effect produced by various micro-organisms was strikingly illustrated in one of the writer's cases, in which he had to deal with a double in-

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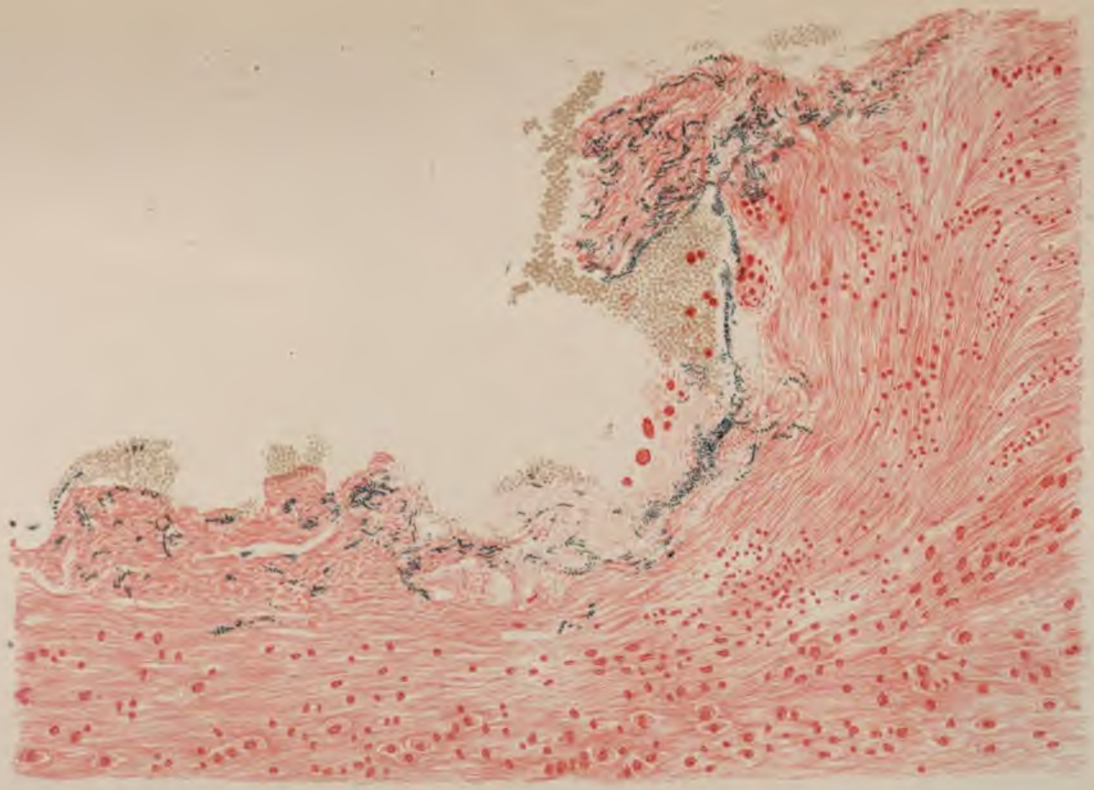
[1] Bumm. Histologische Untersuchungen über die puerperale Endometritis. Arch. f. Gyn., 1891, xl. 398.

[2] Doederlein. Die Beziehungen der Endometritis zu den Fortpflanzungs vorgangen. Verh. d. deutschen Ges. f. Gyn., 1895, 224–242.

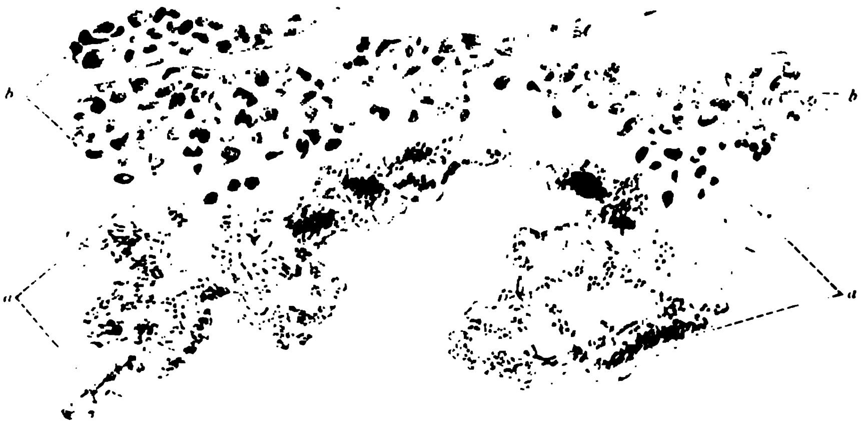
PLATE XXXIV.



Section through Decidua and Uterine Wall, showing Streptococci. (Doederlein.)

PLATE XXXV.

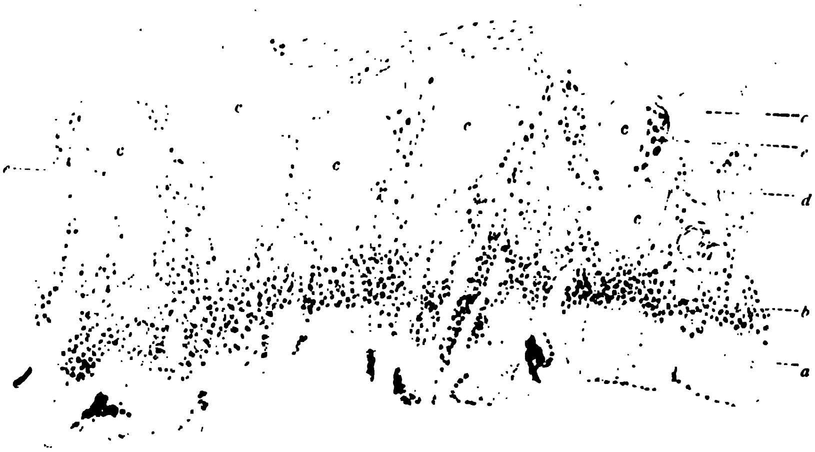
FIG. 1.



Section through Decidua from Putrid Endometritis, removed by Curette on Ninth Day. (Bumm.)

a. Necrotic tissue swarming with bacteria. *b.* Zone of reaction, showing nuclei of leucocytes.

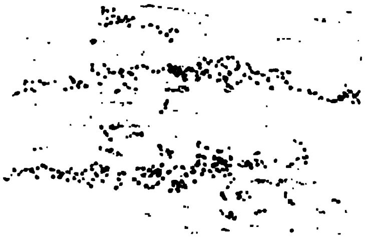
FIG. 2.



Section through Decidua. Septic Endometritis, Curetting on Seventh Day. (Bumm.)

a. Necrotic tissue, bacteria in masses. *b.* Resisting-zone of leucocytes. *c.* Lumen of glands. *d.* Cross-section of bloodvessels. *e.* Remnants of epithelial cells of uterine glands.

FIG. 3.



Streptococci growing between Muscle-fibres. (Bumm.)

fection with the streptococcus and colon bacillus. On making sections through the uterine wall in this case we observed the characteristic necrotic zone lining the cavity of the uterus, and in it both forms of micro-organisms. Beneath this, the zone of small-cell infiltration was fairly well developed, and in its upper part we were likewise able to find both forms of organisms. But in its lower portion we found only the streptococci, which continued their way through the uterus by means of the lymphatics, and on reaching the peripheral surface gave rise to a peritonitis. It would, therefore, appear that nature endeavors to confine the micro-organisms to the interior of the uterus by interposing between the necrotic layer and the deeper portions a wall of small-cell infiltration, which acts as an efficient filter when the micro-organisms are not virulent, but which fails to restrain them when they possess a marked degree of virulency.

PARAMETRITIS. One of the most frequent complications of the uterine infection is parametritis, which is usually due to the propagation of the micro-organisms from the uterus to the peri-uterine connective tissue by means of the lymphatics. The first effect of their invasion is a marked inflammatory œdema, but very little or no suppuration. In mild cases the infection goes only thus far, while in more severe cases it rapidly spreads to the surrounding connective tissue and eventuates in abscess-formation. The infectious agents in severe cases follow the course of the lymphatics, either behind the peritoneum, when they may give rise to retroperitoneal phlegmons, which in rare cases may extend up as high as the posterior mediastinum, while in other cases they follow the lymphatics, which extend into the anterior portion of the pelvis, when we have inflammatory phenomena occurring about the inguinal canal, and in some cases following the connective tissue surrounding the greater vessels of the thigh, when it gives rise to phlegmasia alba dolens.

Occasionally the parametritic involvement has its origin from infected tears about the cervix, but in the vast majority of cases it is due to infection from the uterine cavity.

As has already been pointed out, in a considerable number of cases the endometritic process extends into the uterine wall, and there gives rise to the various lesions of *metritis*, which may vary from small areas of small-cell infiltration to marked abscess-formation. In the majority of cases, however, in which we meet with abscesses scattered through the uterine wall, we find that they are due to lymphatic involvement, and, as the lymphatic supply of the uterus is most marked just beneath the peritoneum, we find the abscesses most frequently in that situation.

SALPINGITIS. In a certain proportion of cases the process extends directly from the uterine cavity to the Fallopian tubes, and there gives rise to various inflammatory phenomena. In a small proportion of cases, however, the salpingitis is due to infection through the lymphatics, and not by continuity from the uterine cavity. In a certain number of cases we observe an *oöphoritis;* here the ovaries are enlarged to several times their usual size, and are very œdematous. The process may stop here or go on to abscess-formation, when we have to deal with a typical ovarian abscess. The ovarian infection in the vast majority of cases is due to lymphatic involvement, and is usually coincident with affections of the parametrium. In a small number of cases, however, the ovarian infection may be due to direct infection of a ruptured follicle by means of the peritonitic fluid.

PERITONITIS. In the vast majority of cases the fatal termination in puerperal infection is due to peritonitis. As we pointed out when considering the histological changes in puerperal endometritis, the streptococci or other infecting agents rapidly make their way from the interior of the uterus to its peritoneal surface by means of the lymphatics, and there give rise to peritonitis. This is the usual mode of infection; but in certain other cases, which, however, occur but rarely, the peritoneum is infected by pus which escapes from the Fallopian tubes, and in other cases by the rupture of parametritic or ovarian abscesses. But in none of the autopsies which the writer has performed upon women dead of puerperal fever has he observed a peritonitis which he could attribute to direct transmission through the tubes.

PYÆMIA. The pyæmic form of puerperal infection usually results from the infection of thrombi at the placental site and the subsequent inflammatory changes occurring in the veins. The thrombosis may be limited to a comparatively small area and be entirely within the uterine wall, or it may extend beyond the uterus, and we occasionally find all the pelvic vessels thrombosed up as high as the junction of the renal veins with the inferior vena cava. By the breaking down of the thrombi small particles escape into the circulation and are carried by the blood-current to various portions of the body, where they give rise to metastatic abscesses, from which apparently no portion of the body is exempt. In this form of puerperal infection we may find metastatic abscesses in all the internal organs, and frequently we find the synovial surfaces affected, giving rise to swellings about the joints, which, if not promptly treated, lead to their complete destruction.

In a number of other cases we notice blebs or bullæ appearing on various portions of the body, which are due to the same cause, and in whose contents we may readily demonstrate the offending micro-organism. In most cases of pyæmia we find very little uterine involvement, and when death occurs it is due to the general exhaustion following a prolonged suppurative process, rather than to peritonitis, which is the usual cause of death in the other forms of infection.

PHLEGMASIA ALBA DOLENS. As we pointed out when considering the question of parametritis, this affection is frequently due to the extension through the lymphatics of the parametritic process to the tissues surrounding the great vessels of the thigh. Usually, however, it results from the extension of thrombosis of the pelvic veins. But in not a few cases it appears to be the only manifestation of the infectious process, and under such circumstances its mode of production is very difficult of explanation.

Etiology. From the consideration of the various bacteria concerned in puerperal infection, it is evident that we have to deal with those organisms with which we are familiar as causing wound-infection; and, generally speaking, we may say that puerperal infection is wound-infection, caused by the introduction of pathogenic organisms within the generative tract, either during or immediately after labor. In other words, we have to deal with a direct infection from without, the infectious germs being brought to the woman by the hands, instruments, or any object which comes in contact with her generative organs.

Puerperal infection is contact-infection, and this conception was first definitely enunciated by Semmelweiss[1] in 1847, in the following words: "I consider puerperal fever, not a single case excepted, as a resorption fever, caused by the resorption of a decomposed organic-animal material. The first result of the absorption is a change in the blood, and the exudations are the result of this change. The decomposed animal-organic material, which when resorbed causes childbed fever, is brought to the individual from without in the greatest majority of cases, and this is infection from without. These are the cases which represent the epidemics of child-bed fever; these are the cases which can be prevented."

In the latter part of the last century puerperal fever began to be considered as a contagious malady in England. This conception apparently originated with Thomas Kirkland,[2] of Ashby, in 1774, but was first clearly enunciated in 1795 by Gordon, of Aberdeen, in his treatise "On the Epidemic of Puerperal Fever, as it prevailed in Aberdeen from December, 1789, to March, 1792," in which he gave a table of 77 cases which he had attended himself.

In this country the man who played the greatest part in introducing the conception of the contagious or infectious nature of the affection was Oliver Wendell Holmes,[3] who in 1843 wrote an article on "Puerperal Fever as a Private Pestilence," in which he clearly showed that it was a preventable affection, and owed its origin either to the accoucheur or midwife. Holmes's teachings, however, did not exert the influence which might have been expected from them; for they were opposed by the leading obstetricians of the country, notably Meigs and Hodge,[4] of Philadelphia, Meigs stating that he preferred to consider puerperal fever as due to the workings of Providence, which he could understand, rather than to an unknown infection of which he could form no conception.

For many years the main theory in Europe as to the causation of puerperal fever was that it was due to miasmatic or atmospheric influence. And this view continued until after the appearance of Semmelweiss's article in 1861, although in 1864 Hirsch,[5] after studying the matter from an historical stand-point, came to the conclusion that it was of infectious rather than of miasmatic origin.

It was not, however, until Lister had introduced antiseptic methods into surgery, and Stadtfelt, of Copenhagen, had recommended the use of bichloride of mercury in obstetrics, that the great mass of the profession began to understand that puerperal fever was due to contact-infection, and could be prevented to a very great degree. After the bacteriological work of Pasteur[6] and his successors, and the constant finding of streptococci in fatal cases, the question was raised above all doubt, and at the present time no one doubts the infectious nature of the disease.

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[1] Semmelweiss. Die Aetiologie der Begriff u. die Prophylaxis des Kindbettfiebers Pest. Wien u. Leipzig, 1861.

[2] Kirkland. Treatise on Childbed Fever, 1774.

[3] Holmes. Puerperal Fever as a Private Pestilence. Boston, 1865.

[4] Meigs. On Childbed Fever. Phila., 1854.

[5] Hirsch. Historisch-pathologische Untersuchungen über Puerperalfieber. Erlangen, 1864.

[6] Pasteur. Septicémie puérpérale. Bull. de l'Acad. de Méd., 1879, 260, 271.

MODES OF EXTERNAL INFECTION. The most usual mode of infection is by the hands of the obstetrician or the midwife, and no one who has observed the way in which the average medical man conducts a labor case can wonder that puerperal fever occasionally occurs. The introduction of dirty instruments, as well as dirty hands, plays an important part in the production of the infection. A source of infection which is frequently overlooked is copulation during the latter weeks of pregnancy; and not infrequently, especially among the lower classes, the woman infects herself by fingering her genitalia, or even by making internal examinations. Contact with secretions from wounds of any kind also plays an important part in its production, and whether the purulent secretion be from an external wound or anywhere within the body, the results will be the same. It is only necessary to recall in this connection the case of Dr. Rutter, of Philadelphia, who was followed wherever he went by an epidemic of puerperal fever, while his brother practitioners were practically free from it. It appeared later that the source of infection in his cases was an ozæna, from which he was constantly infecting his hands.

The disease is often due to wounds on the hands of the nurse, and many cases may be traced to bone-felons and other affections of the fingers, and not infreqently to a pustulous eczema on the hands.

For many years it has been known that physicians attending cases of erysipelas, and then going to women in labor, frequently had to deal with puerperal infection, and one of the old ideas concerning the disease was that it was identical with erysipelas, and it was not until bacteriology showed us that both erysipelas and most cases of puerperal infection are due to the streptococcus that this relation was understood. At the present time the majority of observers believe that there is no essential difference between the streptococcus erysipelatis of Fehleisen and the ordinary streptococcus pyogenes. It has frequently been observed that puerperal fever also occurs in the practice of those attending diphtheria and scarlet fever and occasionally typhoid cases. There is no essential relationship between these affections, but we know that in both diphtheria and scarlet fever we frequently meet with complications which are due to the streptococcus, and these streptococci are conveyed to the woman in labor.

It is generally stated that air infection plays an important part in the production of puerperal infection, and many advise covering the external generative organs with an occlusive pad, to prevent the entry of air within the vagina, and thus avoid this source of infection. It appears to us, however, that air-infection is a very infrequent cause of the disease, if it ever occurs, and we cannot indorse the statements of Garrigues,[1] in his article on this subject in the *American Text-book of Obstetrics*, in which he attributed an epidemic of puerperal fever in the New York Lying-in Hospital to the presence of a dead rat in the cellar. It is much more probable that the epidemic was due to imperfect hand-disinfection on the part of his assistants, or to the introduction of pathogenic organisms within the vagina by the hands of the patients themselves. In England, and to a slight extent in this country, sewer-gas is believed to play a prominent part in the production of puerperal infection, and at a meeting of the health officers of Great Britain in London, some years ago, at which the writer was present, a prominent medical man stated that the first duty of the obstetrician on visiting the house of his patient was to inspect the sanitary arrangements instead of examining the patient. And the writer was informed by good authority that after the serious illness of a prominent woman from puerperal infection, in one of the smaller towns of England, the entire sewerage system of the town was torn up to discover the leak from which the sewer-gas escaped, which was supposed to have been the cause of the disease. There can be no doubt that the danger of infection from the air or from sewer-gas is greatly exaggerated, and it will be spoken of less and less frequently as medical men become better versed in the technique of rigorous hand-disinfection.

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[1] Garrigues. Puerperal Infection. American Text-book of Obstetrics, 1895, 683-734.

To show what an accurate conception Semmelweiss[1] had of the various modes of contact-infection, it may be interesting to quote what he says in this connection : "The bearer of the decomposed animal-organic material is the examining-finger, the operating-hand, instruments, bedclothes, the atmospheric air, sponges, the hands of the midwife or nurses which come in contact with the excrement of women sick with puerperal fever, and after that handle pregnant and parturient women. In other words, the bearer of the decomposed animal-organic material is anything which is soiled by a decomposed animal-organic material and comes in contact with the genitals of these patients."

AUTO-INFECTION. Every one at the present time believes that the vast majority of cases of infection are the result of the introduction from without of pathogenic micro-organisms into the genital canal of the pregnant or parturient woman by means of the examining-finger or in some other way. But many also believe that in a certain number of cases the infection is not due to the introduction of organisms from without, but owes its origin to micro-organisms which were already within the woman before the onset of labor. To infections arising in this way the term "auto-infection" is applied. The term originated with Semmelweiss,[2] who stated : "In rare cases the decomposed animal material, which causes childbed fever when absorbed, is produced within the patient herself. These are the cases of auto-infection, and cannot be prevented."

With the enthusiasm which attended the introduction of antiseptic methods into midwifery, the conception of auto-infection was lost sight of for a time, and it was only when the statistics of well-conducted lying-in establishments showed that a certain amount of infection occurred in spite of the rigorous application of antiseptic principles that the idea of auto-infection was rehabilitated by Ahlfeld[3] and Kaltenbach.[4] Of course, with the recognition of the fact that puerperal fever is due to certain micro-organisms, the definition introduced by Semmelweiss[5] fell to the ground, as it is not possible for the organisms to originate spontaneously within the body of the woman. The conception was then introduced by Kaltenbach[6] that in a considerable number of cases pathogenic organisms are normally found in the vaginæ of pregnant women, which may be introduced into the uterus by the introduction of a perfectly sterile finger within the vagina. It is apparent in such cases that we do not have to deal with auto-infection in the strict sense of the word, and much confusion would have been avoided had the term indirect infection been substituted for it; because the micro-organisms must have been introduced into the vagina at some period of life, and the question simply resolves itself into one of time. Certain observers, notably Slavjansky[1] and Szabo,[2] state that auto-infection, even in this modified sense, is not possible, and that all cases of puerperal infection are due to the introduction of pathogenic micro-organisms at the time of labor.

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[1] Semmelweiss. Die Aetiologie der Begriff u. die Prophylaxis des Kindbettfiebers Pest. Wein u. Leipzig, 1861.

[2] Semmelweiss. Op. cit.

[3] Ahlfeld. Beiträge zur Lehre von Resorptionsfieber im Wochenbett und von der Selbstinfektion. Berichte und Arbeiten, 1883, i. 165. Beitrag zur Lehre der Selbstinfektion. Cent. f. Gyn., 1887, 729.

[4] Kaltenbach. Zur Antisepsis in der Geburtshülfe. Volkmann's Sammlung klin. Vorträge, Nr. 295. Ueber Selbstinfektion. Verh. deutschen Ges. f. Gyn., Freiburg, 1889.

[5] Semmelweiss. Op. cit.

[6] Kaltenbach. Ueber Selbstinfektion. Verh. deutschen. Ges. f. Gyn., Freiburg, 1889.

This appears to be an extreme view, and the question must stand or fall with the results of the bacteriological examination of the generative tract in the pregnant and non-pregnant conditions. If careful investigation shows that pathogenic micro-organisms are absent from the uterus and vagina of pregnant women, we must abandon all idea of auto-infection. If, on the other hand, they can be demonstrated in apparently healthy women during pregnancy, we shall be forced to admit its possibility, no matter what our previous ideas may have been, and to believe that all cases of puerperal fever are not due to infection from without.

Practically all bacteriological investigators are united in claiming that the body of the normal uterus is free from micro-organisms, both in the pregnant and the non-pregnant condition. This fact has been amply demonstrated by the work of Goenner,[3] Doederlein,[4] Winter,[5] Ott,[6] Czerniewski,[7] Stroganoff,[8] Krönig and Menge,[9] and Doederlein and Winternitz,[10] while Strauss and Sanchez-Toledo[11] have demonstrated the same in the lower animals. The only investigators who contend that bacteria can be found in the non-infected uterus are Franz[12] and Burckhardt,[13] who state that they can be demonstrated in its cavity in the latter part of the puerperium in a large proportion of cases. Their results, however, are controverted by the recent work of Doederlein and Winternitz,[14] and appear invalidated by the fact that the writer found the uterine lochia absolutely sterile in 26 out of 150 women who presented rises of temperature in the puerperium (p. 590).

[1] Slavjansky. Die Antiseptik in der Geburtshülfe. Verh. de x. internat. med. Congresses, 1891, iii. Abth. vii. 1.

[2] v. Szabo. Zur Frage der Selbstinfektion. Arch. f. Gyn., 1889, xxxvi. 77-101.

[3] Goenner. Ueber Mikroörganismen in Sekrete der weiblichen Genitalien während der Schwangerschaft und bei puerperalen Erkrankungen. Centralbl. f. Gyn., 1887, 444.

[4] Doederlein. Untersuchung über das Vorkomen von Spaltpilzen in den Lochien des Uterus und der Vagina gesunder und kranker Wöchnerrinnen. Arch. f. Gyn., 1887, xxxi., 412.

[5] Winter. Die Mikroörganismen im Genitalkanal der gesunden Fraun. Zeitschr. f. Geb. u. Gyn., 1888, xiv. 443.

[6] Ott. Zur Bacteriologie der Lochien. Arch. f. Gyn., 1888, xxxii. 436.

[7] Czerniewski. Zur Frage von den puerperalen Erkrankungen. Eine bakteriologische Studie. Arch. f. Gyn., 1888, xxxiii. 73.

[8] Stroganoff. Bakteriologische Untersuchungen des weiblichen Genitalschlauches. Centralbl. f. Gyn., 1897, 935. Bakteriologische Untersuchungen des Genitalkanales beim Weibe in verschiedenen Perioden ihres Lebens. Monatsschr. f. Geb. u. Gyn., 1895, ii. 365-399, 494-504.

[9] Krönig. Scheidensekret-untersuchungen bei 100 Schwangeren. Aseptik in der Geburtshülfe. Centrabl, f. Gyn., 1894, 3-10.

[10] Doederlein and Winternitz. Die Bakteriologie der puerperalen Sekrete. Hegar's Beiträge zur Geb. u. Gyn., iii. 161-174, 1900.

[11] Strauss and Sanchez-Toledo. Septicémie puérpérale expérimentale. Nouv. Arch. d'obstét. et de gyn., 1889, cv. 277-95.

[12] Franz. Bakteriol. und. klinische Untersuchungen über leichte Fiebersteigerungen in Wochenbette. Hegar's Beiträge zur Geb. u. Gyn., iii. 51-100, 1900.

[13] Burckhardt. Ueber den Keimgehalt der Uterushöhle bei normalen Wochnerrinnen. Centralbl. f. Gyn., 1898, 686-89.

[14] Ibid.

When we come to consider the bacterial contents of the cervix in the healthy woman, we find that the conclusions are not so uniform. Thus, Winter,[1] Doederlein,[2] and other observers state that micro-organisms are present in the cervical canal in most cases; while, on the other hand, Stroganoff[3], and Goebel[4] state that they are usually absent. Goenner[5] and Walthard[6] believe that it is normally sterile in all cases.

The contradictory results of the various observers were apparently satisfactorily reconciled by Walthard's[7] work. He found that cultures taken from the lower portion of the cervical canal contained identically the same micro-organisms as the vagina, but that they became less plentiful as the internal os was approached, disappearing altogether about one-third of the way up. It would therefore appear that the observers who found bacteria in the cervix obtained the secretion from the lower portion of its canal; while those who reported negative results obtained the secretion from higher up. Accordingly, we may conclude that both the uterus and the upper portion of the cervix are practically, if not absolutely, sterile; and can therefore offer no possibility for the occurrence of auto- or indirect infection.

The question accordingly resolves itself into the demonstration of the presence or absence of pathogenic micro-organisms in the healthy vagina, and, accordingly as this can be done, the doctrine of auto-infection must be generally accepted or absolutely abandoned. Ahlfeld,[8] in all his articles upon the subject, states that " the vagina is swarming with various varieties of pathogenic organisms, and auto-infection can only be prevented by thoroughly disinfecting the vagina in every case by antiseptic douches."

Unfortunately, the bacteriological investigations as to the bacterial contents of the vaginal secretion of pregnant women have not led to absolutely satisfactory and conclusive results. On the one hand, the work of Goenner,[9] Thomen,[10] Samschin,[11] Krönig and Menge,[12] Bensis,[13] and the writer[14] in 1898, appear to show that pathogenic micro-organisms, with the exception of the gonococcus, cannot be found in the vagina of pregnant women; while, on the other hand, numerous investigators have demonstrated the presence of streptococcus in a varying proportion of their cases, as shown by the following table:

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[1] Ibid.

[2] Ibid.

[3] Ibid.

[4] Göbel. Der Bakteriengehalt der Cervix. Centralbl. f. Gyn., 1896, 81.

[5] Ibid.

[6] Walthard. Bakteriologische Untersuchungen des weiblichen Genitalsekretes in der Gravidität und in Puerperium. Arch. f. Gyn., 1895, xlviii. 201-269.

[7] Ibid.

[8] Ahlfeld. Beiträge zur Lehre von Resorptionsfieber im Wochenbett und von der Selbstinfektion. Berichte und Arbeiten, 1883, i. 165. Beiträg zur Lehre der Selbstinfektion. Centralbl. f. Gyn., 1887, 729. Beiträge zur Lehre vom Resorptionsfieber in der Geburt und im Wochenbette und von der Selbstinfektion. Zeitschr. f. Geb. u. Gyn., 1893, xxvii. 466-519.

[9] Ibid.

[10] Thomen. Bakteriologische Untersuchungen normaler Lochien und der Vagina und Cervix Schwangerer. Arch. f. Gyn., 1889, xxxvi. 231.

[11] Samschin Ueber das Vorkomen von Eiterstaphylococcen in den Genitalien von gesunder Frauen. Deutsche med. Wochen., 1890, 232.

[12] Ibid.

[13] Bensis. Récherches sur la flore vulvaire et vaginal chez la femme enceinte. Thèse de Paris, 1900.

[14] Williams. The Bacteria of the Vagina and their Practical Significance, based upon the Bacteriological Examination of the Vaginal Secretion of Ninety-two Pregnant Women. Amer. Jour. Obstet., 1898, xxxviii. 449-483.

	Per cent.		Per cent.
Burckhardt[1]	4	Witte[7]	12.5
Steffeck[2]	4	Kottmann[8]	13
Doederlein[3]	4.1	Winter[9]	15
Burguburu[4]	8.5	Williams[10] (1893)	20
Koblanck[5]	9.5	Vahle[11]	25
Vahle[6]	10	Walthard[12]	27

Thus, it seems, on the one hand, that bacteriological work appears to prove that auto-infection is absolutely impossible; while, on the other hand, it indicates that it may occur in a varying percentage of cases.

The appearance of Doederlein's[13] work on the vaginal secretion, in 1892, appeared to reconcile for a time the conflicting results which were based upon the bacteriological work which had been done up to that date. He pointed out that the vaginal secretion might occur in one or two forms, which he designated as normal and pathological. The normal secretion, according to him, was a thick, dry, cheese-like material, of a whitish color and distinctly acid reaction. Microscopically it contained epithelial cells, a pure culture of tolerably long bacilli, and now and then a few yeast fungi. It did not contain pathogenic micro-organisms, and offered absolutely no support for the doctrine of auto-infection. On the other hand, the pathological secretion was fluid, generally of a yellowish color suggesting pus, and occasionally contained gas-bubbles. In it were found large numbers of leucocytes, many micro-organisms of various kinds, and in a few cases streptococci. Its reaction was less acid than in the normal secretion, was occasionally neutral, and in a few cases even alkaline. Doederlein's work was based upon the examination of 190 pregnant women, 55.3 per cent. of whom presented normal, and 44.6 per cent. pathological secretion. And in 10 per cent. of the latter he was able to demonstrate the presence of streptococci by cultural methods. His investigations, accordingly, indicated that auto-infection could not possibly occur in women with normal secretion, whereas abundant theoretical facilities were present for it in 10 per cent. of the pathological cases.

He supposed that the contradictory results of the investigators who had worked upon the subject up to that time could be reconciled by supposing that those obtaining negative results had worked with the normal, and those obtaining positive results with the pathological secretion.

Krönig,[14] in 1897, stated that he had examined the vaginal secretion of 167 pregnant women, and that in none of them was he able to demonstrate typical streptococci or any other pathological micro-organisms, with the exception of the gonococcus. He therefore concluded that the vaginal secretion should be considered as aseptic, and believed that it did not offer the slightest evidence in support of the doctrine of auto-infection. He stated that in all probability the conflicting results of the various observers were due to the different methods by which they obtained the secretion for examination; and whenever it was obtained by means of a speculum that it was probable that pathogenic micro-organisms had been carried up along with it from the vulva; and he therefore recommended that it be obtained by means of a small tube, which could be introduced into the vagina under the guidance of the eye, without coming in contact with the labia minora or the margins of the hymen.

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[1] Burckhardt. Ueber den Einfluss der Scheidenbakterien auf dem Verlauf des Wochenbettes. Arch. f. Gyn., 1893, xiv. 71-94.

[2] Steffeck. Bakteriologische Begründung der Selbstinfektion. Zeitschr. f. Geb. u. Gyn., 189 xx. 339.

[3] Doederlein. Das Scheidensekret. und seine Beudeutung für das Puerperalfieber. Leipzig, 1892.

[4] Burguburu. Zur Bakteriologie des Vaginalesekretes Schwangeren. Arch. f. exper. Path. und Pharmak., Nov., 1892, xxx.

[5] Koblanck. Zur puerperalen Infection. Zeitschr. f. Geb. u. Gyn., 1899, xi. 85-92.

[6] Vahle. Ueber das Vorkomen von Streptococcen in der Scheide Gabärender. Zeitschr. f. Geb. u. Gyn., 1896, xxxv. 192-215.

[7] Witte. Bakteriologische Untersuchungschefunde bei path. Zustände imweibl. Genitalapparat. mit besonderer Bezüchsichtigung der Eiterreger. Zeitschr f. Geb. u. Gyn., 1892, xxv. 1.

[8] Kottmann. Beitrag zur Bakteriologie der Vagina. Arch. f. Gyn., 1898, lv. 615.

[9] Ibid.

[10] Williams. Puerperal Infection, considered from a Bacteriological Point of View, with Special Reference to the Question of Auto-infection. Amer. Journ. Med. Sci., July, 1893.

[11] Ibid.

[12] Ibid.

[13] Ibid.

[14] Krönig. Bakteriologie des Genitalkanales der schwangeren, kreissenden u. puerperalen Frau. Leipzig, 1897.

In 1898, the writer[1] reported to the American Gynecological Society the results which he had obtained from the examination of the vaginal secretion of 92 pregnant women, from whom he had obtained the secretion by means of a small tube similar to that employed by Krönig and Menge. In none of these cases did he find the streptococcus or staphylococcus aureus, but in 6 cases he demonstrated the staphylococcus epidermidus albus. Whether the latter really existed in the vagina, or were due to contamination, is open to doubt; but as these organisms are never found in severe cases of puerperal infection, their presence in the vaginal secretion is a matter of indifference as far as the question of auto-infection is concerned. He accordingly stated that he could confirm Krönig's[2] observations as to the absence of pyogenic cocci from the vaginal secretion of pregnant women, and believed that auto-infection due to them could not occur, although he was not prepared to state that it might not occasionally occur from other bacteria, especially in some of the cases of putrefactive endometritis.

These conclusions were absolutely contradictory of those to which the writer[3] arrived five years previously, when he was able to confirm Doederlein's[4] original work by finding streptococci in 20 per cent. of the vaginal secretions which he examined. The only possible explanation for the different results obtained in the two series of investigations must be sought in the manner in which the secretion was obtained for examination, as all the other conditions under which the work was carried out were identical. In the first series the secretion was obtained by means of a sterile glass speculum, and in the second by means of Menge's tube; and it appeared probable, when the speculum was used, that a number of bacteria were carried into the vagina by it from the margins of the hymen and the inner surface of the labia minora, with which it had come in contact; while such contact was avoided when the tube was employed, whereby the secretion was obtained absolutely free from contamination.

This explanation was placed beyond doubt by the examination of 25 additional cases by the writer,[5] from each of which three sets of cultures were made. The first were taken from the hymen and inner surface of the labia minora, the second from the vaginal secretion obtained by means of Menge's tube, and the third from the vaginal secretion obtained by means of a sterilized speculum. Pyogenic cocci or colon bacilli were demonstrated in 80 per cent. of the first series of experiments, in none of the second, and in 48 per cent. of the third series, thereby showing conclusively that the vaginal secretion is absolutely free from pyogenic cocci when obtained without contamination; but that bacteria are present upon the hymen and labia minora in most cases, and that it is impossible to introduce a speculum into the vagina without carrying along with it, in at least one-half of the cases, the bacteria which are present upon the vulva.

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[1] **Williams.** **The Cause of the Conflicting Statements Concerning the Bacterial Contents of the Vaginal Secretion of the Pregnant Woman.** Amer. Journ. Obstet., 1898, xxxviii. 807–817.

[2] Ibid.

[3] See note 10, page 602.

[4] Ibid.

[5] See note 1.

As a result, therefore, of the work of Krönig and Menge[1] and the writer, we consider that it has been fairly satisfactorily demonstrated that pyogenic cocci are never present in the vagina of pregnant women, and that therefore there is no possibility of auto-infection as far as those organisms are concerned; and whenever they are demonstrated in the uterine secretion of puerperal women they should be regarded as distinct evidence of external infection. At the same time it is possible, in rare cases, that auto-infection may occur from certain anaërobic organisms which are found in the vaginal secretion, but satisfactory evidence cannot be adduced in support of such an occurrence until methods have been devised which will enable us to isolate and cultivate satisfactorily in pure cultures the organisms in question.

The gonococcus forms an exception in this regard, as it is well known that it is the only pyogenic coccus which can live and thrive in the vaginal secretion. As we have already indicated, it is not infrequently the cause of an elevation of temperature during the puerperium. But such cases should not be considered as supporting the doctrine of auto-infection, for the reason that women were usually infected either before becoming pregnant or in the first few months after its occurrence, after which the organisms persist in the crypts of the cervical canal, where they live as parasites, and simply find more suitable conditions for development in the first few days of the puerperium, when they make their way up into the uterine cavity and manifest their presence by the production of fever and an increased discharge.

An interesting fact in connection with the question of auto-infection is that those who believe most in its possibility, and resort to the employment of the prophylactic vaginal douches for the destruction of the organisms in the vagina, present far less favorable statistics than those who take the opposite view. Thus, for example, Ahlfeld,[2] who is the most pronounced believer in auto-infection, finds that 38 per cent. of his cases present a rise of temperature even after the use of the prophylactic douche. The results of Kaltenbach, who was a consistent believer in auto-infection, and resorted to the routine employment of the prophylactic douche, have undergone very material improvement since Fehling[3] discontinued its use, after taking charge of the Clinic in Halle. And the results of Leopold[4] and Mermann,[5] who do not use the douche at all, show constant improvement, with the increasing precision with which objective asepsis is carried out.

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[1] Ibid.

[2] Ahlfeld. Beiträge zur Lehre vom Resorptionsfieber in der Geburt und Wochenbette und von der Selbstinfektion. Zeitschr. f. Geb. u. Gyn., 1893, xxvii. 466–519.

[3] Fehling. Ueber die Erkrankungsziffern Entbindungshäuser. Deutsche med. Woch., 1896, 426.

[4] Leopold. Ueber die Wochenbetten von nicht untersuchten und nicht ausgespülten Gebärenden. Verh. deutsche Ges. f. Gyn., Freiburg, 1889. Dritter Beitrag zur Verhütung des Kindbettfiebers. Arch. f. Gyn., 1889, xxxv. 149–162. Vergleichende Untersuchungen über die Entbehrlichkeit der Scheidenausspülungen bei ganz normalen Geburten und über die sogenannte Selbstinfektion. Arch. f. Gyn., 1894, xlvii. 580–635. Ueber die Entbehrlichkeit der Scheidenausspülungen und Auswaschungen bei regelmässigen Geburten und über die grösstmögliche Verwerthung der äusseren Untersuchung in der Geburtshülfe. Arch. f. Gyn., 1891, xl. 439.

[5] Mermann. Zur Antisepsis in der Geburtshülfe. Centralbl. f. Gyn., 1887, 439. Die Entbehrlichkeit und Gefahren innerer Desinfektion normalen Geburten. Verh. deutsche Ges. f. Gyn., Freiburg, 1889. Fünfter Bericht über 200 Geburten ohne innere Desinfektion. Centralbl. f. Gyn., 1885, 177. Sechster Bericht über Geburten ohne innere Desinfektion. Centralbl. f. Gyn., 1894, 786.

The prophylactic value of the vaginal douche has recently been investigated by Krönig[1] and Bretschneider,[2] and the latter reports 2280 cases from the Leipzig Clinic, in which every alternate case was douched; and shows that the puerperium was febrile in 45.18 per cent. of the cases in which the douche was used, as compared with 36.78 per cent. of the cases in which it was not employed.

In a recent article by Jewett[3] the opinions of most American obstetricians on this subject are quoted, from which it appears that most of them do not employ the prophylactic douche; and that, while a certain number of them theoretically believe in auto-infection, they practically act as if its occurrence were impossible.

Frequency. It is very difficult to make accurate statements as to the frequency of puerperal infection, especially when it occurs outside of hospital practice; for the consideration of the vital statistics of the health officers of the various cities fails to give any idea as to the frequency with which the disease occurs, because the vast majority of deaths from it are not reported as such, but as malaria, typhoid fever, pneumonia, etc.; for the laity have learned that puerperal fever is a preventable affection, and when it occurs are inclined to lay the blame upon the physician in charge of the case, which he usually attempts to shirk by stating that death was due to some other affection.

That the tables prepared by the various health officers give no idea as to the frequency of death from puerperal infection is made very evident by the statement of Reynolds,[4] who in 1893 attempted to write an article upon the prevalence of puerperal fever in Boston. But on looking over the statistics furnished by the health office he found that he had seen during that year, if the reports of the department were accurate, more than one-fourth of all the cases of this character in Boston. Reynolds himself saw 28 cases in hospital and consultation practice, with 7 deaths; and it is evident that many more than 28 women died from the affection in Boston during that time.

Since the introduction of antiseptic and aseptic methods into midwifery the mortality from puerperal infection has diminished very markedly in hospital practice. In the old maternity of Paris and in the lying-in hospital of Vienna it was not at all infrequent to find years in which the mortality from this affection varied between 10 and 15 per cent. of all the women entering the institution. Just before the introduction of antiseptic methods the frightful mortality occurring in such institutions attracted the attention of the public at large, and steps were being instituted to abolish them as a menace to public health. With the introduction of aseptic methods, however, all this has changed, and in well-regulated lying-in institutions at the present time the mortality from sepsis is usually only a fraction, and a small fraction at that, of 1 per cent. And at present, in the discussions on puerperal infection, at least as far as hospitals are concerned, the question is one of morbidity, namely, the number of patients whose temperature during the puerperium rises above 38° C. or 100.4° F., rather than of mortality.

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[1] Krönig. Klinische Versuche über den Einfluss der Scheiden-spülungen während der Geburt. auf der Wochenbettsverlauf. Münchener med. Wochen., 1894, No. 1.

[2] Bretschneider. Klinische Versuche über den Einfluss der Scheidenspülungen währen der Geburt auf den Wochenbettsverlauf. Arch. f. Gyn., 1901, lxiii. 453-71.

[3] Jewett. The Question of Puerperal Self-infection. Amer. Gyn. and Obst. Journ., 1896, viii. 417-429.

[4] Reynolds. The Frequency of Puerperal Sepsis in Massachusetts, etc. Boston Med. and Surg. Journ., cxxxi. 153-155.

On the other hand, in private practice it is questionable whether the results of to-day are materially better than before the introduction of antiseptic methods. At the present time we rarely hear of epidemics of puerperal infection such as occurred previously, and which we find mentioned in the historical work of Hirsch,[1] who gives us the particulars of 216 epidemics occurring between the years 1652 and 1862.

At the same time, it would appear to us that puerperal infection is almost as frequent in private practice now as fifteen years ago, for the reason that the doctrines of asepsis have not yet permeated the rank and file of medical men, much less those of the midwives, in whose hands a very large proportion of all obstetrical cases occur.

Bacon,[2] in a recent article, based upon the records of the health department of Chicago, shows that puerperal infection still plays a very prominent part in the death list. His statistics embrace the last forty years, during which period he estimates that 12.75 per cent. of all women dying between the ages of twenty and fifty years succumbed to puerperal sepsis. In 1873, 20 per cent. of all women dying between these ages perished from it. Since then the mortality has gradually fallen, reaching 6 per cent. in 1892, at which figure it has since remained, reaching 7.3 per cent. in the year 1895. These results are substantiated by those of Ingerslev,[3] who states that even at the present time in Denmark puerperal infection is the most frequent cause of death in women between the ages of twenty and fifty years, with the single exception of tuberculosis.

Boxall,[4] in an article on the mortality of childbirth, which appeared in the *Lancet* in 1893, has tabulated the statistics of the Registrar General's Office for forty-five years—that is, from 1847 to 1892. His tables give the average mortality for every 100,000 confinements for England and Wales, for London, and for the provinces, and in this way he is able to accentuate the difference between the results in London itself and the counties. He then divided his statistics into those occurring before 1860 and those occurring since 1880, so as to permit of comparison between the results obtained in the pre-antiseptic and antiseptic eras. And he found that in London the deaths in childbirth from all causes had decreased since 1880 from 54 to 37 deaths per 100,000; but that this decrease was due almost entirely to the decrease in the number of deaths from the accidents of childbirth, and to a better and prompter application of instrumental procedures; while in the counties the death-rate from all causes is nearly as great as it was thirty years ago, thus showing that the application of antiseptic and aseptic methods had not permeated the ranks of the profession, and that outside of the lying-in hospitals the results are as bad to-day as twenty or even forty-five years ago.

In considering the frequency of puerperal infection we should not be guided altogether by the consideration of its mortality, for the largest proportion of these cases do not result in death. But any one who has had an opportunity of observing a number of gynecological cases cannot fail to be impressed with the very large proportion of cases coming into his hands which owe their origin to febrile affections during the puerperium, which are preventable for the great part, and are due to the neglect of aseptic precaution on the part of the physicians in charge.

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[1] Hirsch. Historisch-pathologische Untersuchungen über Puerperalfieber. Erlangen, 1864.

[2] Bacon. The Mortality from Puerperal Infection in Chicago. Amer. Gyn. and Obst. Journ., 1896, viii. 429–446.

[3] Ingerslev. Die Sterblichkeit an Wochenbettfieber in Dänemark und die Bedeutung der Antiseptik für disselle. Zeit. f. Geb. u. Gyn., 1893, xxvi. 443.

[4] Boxall. The Mortality of Childbirth. Lancet, 1893, ii, 9–15.

Symptomatology. According to the statements of Labadie-Lagrave and Basset,[1] we rarely meet with the virulent forms of puerperal infection with which our predecessors had to deal. They consider that in the vast majority of cases we meet with attenuated forms of the affection, whose modified course, in all probability, is due to the more or less rigorous application of antiseptic principles, which results in a diminution of the virulence of the offending organisms. According to them, in the cases of sepsis without definite localization, the symptoms are not so severe as formerly, and a considerable number of patients recover; while in other cases the infection does not make its appearance until the latter part of the puerperium, and then only in a comparatively mild form.

As stated when considering the pathological anatomy of puerperal infection, its most usual manifestation is an endometritis, which may be either of the septic or putrid variety. The symptoms vary considerably according to the form with which we have to deal, and we shall first consider those of the septic variety.

In the cases of septic endometritis everything goes smoothly for the first three or four days of the puerperium, when our patient, who thus far has done perfectly well, suddenly experiences more or less malaise, possibly has a headache, and toward the end of the third or fourth day a chill, after which the temperature rises to 103° F. or more. Generally the chill occurs but once, while the temperature remains constantly elevated. At the same time there is considerable tenderness in the lower part of the abdomen, the uterus is larger and more doughy in consistency than it should be, and is more or less sensitive on pressure. The lochial discharge is usually increased in quantity, and is a bloody, more or less purulent secretion, which in the purely septic forms is practically devoid of color. If the temperature is very high, it is not infrequently diminished in amount, and may occasionally almost disappear. The absence of odor from the uterine discharges in these cases is of the greatest practical importance, for the average practitioner associates puerperal infection with profuse and foul-smelling lochia; while the fact is that in the most virulent cases, and especially those due to pure streptococcus infection, there is very little, if any, odor to be noticed.

Another point of importance is the faulty involution of the uterus. This must be looked upon as a factor which plays an important part in the further spread of the disease; for, as we have already stated, the micro-organisms make their way from the endometrium through the muscular walls of the uterus by means of the lymphatics, and, when the uterus is markedly relaxed, it is apparent that the lymph-channels must be more patent and offer far less resistance to their outward passage than when the uterus is firmly and normally contracted.

The further history of septic endometritis varies according as the process remains limited to the cavity of the uterus or extends beyond it.

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[1] **Labadie-Lagrave and Basset.** La sépticémie puérpérale attenuée (étude bacteriologique). **Congrès period. internat. de gyn.** et d'obstét., 1892. Brux., 1894, i. 319-325.

If it remains limited to the uterus, the temperature gradually falls, the secretion becomes less and less, and the patient is slowly restored to health. In the majority of cases, however, the uterine mucosa is not restored to its normal condition at once, but for a long time remains in a condition of subacute or chronic inflammation. If, on the other hand, the process extends beyond the uterus, the symptoms will vary according to the organs involved, and the clinical picture will be complicated by the appearance of symptoms characteristic of a parametritis, peritonitis, or pyæmia.

The symptoms of putrid endometritis vary considerably from those of the septic form. In this we likewise have the initial chill and the high temperature, but the patient's condition does not usually appear so serious. But the main difference between the two varieties of the affection is to be noted in the character of the uterine discharge, which in the putrid cases is abundant, very foul-smelling, and frequently contains large numbers of gas bubbles, which give it a frothy appearance. These cases usually recover, and only in rare instances give rise to a fatal termination.

Between these two well-marked classes of cases, however, there exist all forms of gradation, for we frequently have to deal with a mixed infection due to pyogenic as well as putrefactive organisms.

As already indicated when considering the pathological anatomy of the puerperal ulcer, it is not infrequent to find the chill and rise of temperature associated with an ulcer about the vulva or somewhere in the vagina. In the vast majority of cases, however, the puerperal ulcer does not occur alone, but is usually associated with an endometritis. The same may be said of puerperal vaginitis, for it is extremely rare for the infection to be limited to the vagina.

If the process has extended from the uterine cavity or from ulcers about the cervix to the parametrium, we meet with symptoms which are more or less characteristic of the affection. In many cases the initial rise of temperature gradually disappears, and we are congratulating ourselves that our patient has escaped so easily, when suddenly there is a chill and the temperature rises again, and then pursues a more or less irregular course, usually marked by exacerbations in the evening.

This may continue for a longer or shorter period without any local manifestation, but sooner or later, on abdominal palpation, we feel a mass arising on one or both sides of the uterus, which is due to abscess formation within the folds of the broad ligament. This abscess may be limited to the broad ligament itself, or may follow the lymphatics of the pelvic connective tissue along the anterior portion of the pelvis up to the neighborhood of Poupart's ligament, or extend backward toward the retroperitoneal region. The temperature will continue until the abscess has ruptured spontaneously or been opened with the knife, except in a few cases in which it undergoes gradual resorption, leaving a mass of cicatricial tissue to mark its former situation. Unless the parametritic abscess ruptures into the peritoneal cavity, the patients usually recover. If not operated upon, the abscess may burst into the rectum or bladder, and occasionally through the abdominal wall in the inguinal region.

In a certain number of cases the infection extends from the uterine cavity to the Fallopian tubes, and there gives rise to a salpingitis with its accompanying symptoms, and many a case of pyosalpinx, which is operated upon later, is the result of such a process.

Unfortunately, in a considerable number of cases, the infection does not remain limited to the uterus or the parametrium, but the micro-organisms make their way through the lymphatics of the muscular wall of the uterus to the peritoneum, where they give rise to a peritonitis. In rare instances the peritonitis is the result of extension of the process from the tubes, and in still other cases to the rupture of a parametritic abscess or pyosalpinx.

In a small number of cases the peritoneal involvement is limited to the portion lining the pelvic cavity, when we have to deal with a pelvic peritonitis. If the process remains limited, the chances are that it will eventuate in recovery; but if a greater portion of the peritoneum be involved, the death of the patient is to be predicted. The characteristic symptoms of peritonitis may make their appearance at almost any time during the puerperium, but rarely before the third or fourth day, or later than the end of the first week, unless it be due to the rupture of an abscess.

When the patient is infected with virulent streptococci, the endometritic involvement is usually very slight, and the first sign of infection appears from the side of the peritoneum. Here we notice the chill and the high temperature, which remains constantly elevated; the pulse becomes rapid and in the latter part of the affection very weak and thready. The patient complains of intense pain, which is at first limited to the lower portion of the abdomen, but gradually extends over the entire abdomen. At the same time there is marked tympanites, and the abdominal walls are rendered firm and tense by the distended intestines. If a fatal issue ensues, death usually occurs within the first ten days of the puerperium, the patient gradually sinking and dying in a conscious condition.

In the cases of pyæmia, on the other hand, where the organisms have made their way into the venous channels, the clinical picture is very different. Here the initial chill does not occur so soon and the temperature does not remain constantly elevated, but instead we have a typical hectic fever, with the alternating chill, high temperature, and remission. The symptoms of pyæmia vary very considerably, according as it is the result of the dislodgement of a single thrombus, or of the constant supply of the blood with small portions of infected thrombi. In the first instance we have a metastasis produced at some one point, whose symptoms will vary according to the organ involved. On the other hand, if the thrombi are being constantly dislodged we may have symptoms referable to various organs.

One of the most constant symptoms of pyæmia is an infectious bronchopneumonia, which frequently leads to a fatal termination. In other cases we notice swellings at the various joints which frequently eventuate in suppuration and lead to their total destruction. The course of pyæmia varies very materially according to the organs involved and the power of resistance of the patient, and is nothing like so uniformly fatal as the peritonitic form of infection.

In a certain number of cases, the infection is so virulent that the organisms do not have a chance to become localized in any one organ, and we find them and their toxins in very large numbers in the blood, with very slight involvement of the uterus. This we designate as septicæmia, which is the most rapidly fatal form of infection; the patients in many instances dying on the second or third day of the puerperium in a condition of shock, and without the development of local symptoms, the writer having recently observed a case of pure streptococcus infection in the out-patient department, which ended fatally eighteen hours after the initial rise of temperature.

In a small number of cases infected thrombi, instead of going to the lungs or other organs, make their way into the femoral vein and there give rise to phlegmasia alba dolens. This usually does not make its appearance until some time in the second week of the puerperium, or later, when the patient begins to complain of more or less pain in the line of the femoral vessels in one limb and soon notices a swelling of the part, which extends from above downward. This affection is extremely painful and usually lasts for a considerable time, but does not lead to death unless some complication occurs. In many cases of phlegmasia the onset of the disease is associated with pain about the chest. This symptom has been dwelt upon by Pinard and Wallich[1] in their recent work on the treatment of puerperal infection, and attributed by them to the involvement of the pleuræ by small thrombi, which gives rise to isolated areas of pleurisy.

In a certain number of cases, infection may occur before the birth of the child. These we designate as "infection *intra-partum*." This usually occurs in slow labors in which the membranes are ruptured at an early period. In these cases the temperature may be markedly elevated and the patient present a markedly septic appearance during the progress of labor. When the temperature during labor rises above 100.5° F. we should always think of this complication, which should indicate its speedy termination.

Diagnosis. The diagnosis of puerperal fever does not usually offer any difficulty to the physician in charge, as the clinical history is very significant.

If a patient who has been previously well has a chill and rise of temperature on the third or fourth day of the puerperium, we may be practically sure that we have to deal with an infection, unless we can account for the symptoms by some other perfectly apparent cause. In many cases the initial chill does not occur, and we simply have the rise of temperature, and we may say in general terms that a temperature of 100.4° F. or higher, which persists for more than twenty-four hours, is, *a priori*, evidence of infection.

In the old times it was believed that the onset of the lacteal secretion was accompanied by fever, and the older observers always looked for a rise of temperature on the third or fourth day, and designated it as "milk fever." At the present time, however, we no longer believe in its occurrence, as we know that the normal puerperium should be absolutely free from fever. It is customary, in speaking of the puerperium, to consider a rise of temperature to 100.4° F. or 38° C., as within the bounds of normal. But when this point is reached we are obliged to look for some cause for the temperature, which in the vast majority of cases will be found in an infection from without.

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[1] Pinard and Wallich. Traitement de l'infection puérpérale. Paris, 1896.

After the infection has become well established, either as endometritis, peritonitis, or one of the other forms, the diagnosis is usually easy. In the cases of puerperal endometritis in which there is no involvement of the perimetrium or parametrium, usually very little pain is observed, and it occasionally becomes a difficult matter to decide positively whether the temperature is due to a uterine infection or to some other cause.

In a certain number of instances, we may observe a rise of temperature on the third or fourth day of the puerperium, which may be due to mental causes, such as emotional excitement, fright, or grief. In such cases the temperature rises suddenly, and may reach a considerable height, and promptly falls within a few hours to the normal. These cases at the onset may simulate an infection, and it is only by the rapid subsidence of the symptoms that we are able to make a diagnosis.

In a certain number of cases also, we may have a rise of temperature caused by auto-infection from the intestinal tract. Special attention has been devoted to this subject by Budin[1] and Galtier,[2] who state that in some instances such a condition may closely simulate puerperal infection. The diagnosis is readily made, however, by the administration of a strong laxative, for after a copious movement of the bowels the temperature rapidly falls and remains at the normal line.

We not infrequently notice a rise of temperature occurring in the early part of the puerperium, which is due to inflammatory troubles about the breasts, but the subsequent history of the case readily clears up the question of diagnosis.

These are the most usual causes of rises of temperature during the puerperium which are not connected with puerperal infection. But many intercurrent affections may give rise to a chill and high temperature, which for a short time may cause us to fear puerperal infection; but the subsequent history of the case soon teaches us that our fears are groundless. This is frequently the case in angina and the acute pulmonary affections, which may occur at any time during the puerperium. There are two diseases, however, which are frequently confounded with puerperal fever, and which are also made the scapegoat to shield the practitioner who has neglected aseptic precautions in the conduct of his case. These are malarial fever and typhoid fever. There is no doubt that either of these affections may occur during the puerperal period, but in the vast majority of cases the diagnosis is made to shield the practitioner from the consequences of his own neglect.

Occasionally, in prolonged suppurative processes about the pelvis we have symptoms which may readily be confounded with one or the other of these affections, but in the present state of our knowledge there is no reason why we should long remain in doubt as to the cause and origin of the fever in a given case.

If we have to deal with malaria, we should be able to demonstrate in the blood the presence of the malarial plasmodium, and, unless the blood has been carefully examined and the malarial organism demonstrated, we do not consider that one is justified in regarding as malarial any puerperal patient who has an elevated temperature and an occasional chill.

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[1] Budin. La Semaine méd., 1896, 155.

[2] Galtier. De l'infection primitive du liquide amniotique après la rupture prematurée des membranes de l'oeuf humain. Thèse de Paris, 1895.

The writer in his own practice goes still further than this, and would not attribute a rise of temperature in the puerperium to malaria to the exclusion of puerperal infection, unless he had conclusively demonstrated the presence of the malarial organisms in the blood of the patient, and likewise demonstrated by cultural methods that the uterine cavity was free from all pathogenic organisms; for it is possible that in a certain number of cases we may have puerperal infection associated with malarial poisoning, and under such circumstances, without the bacteriological examination of the uterine lochia, we would be satisfied of the malarial origin of the symptoms upon finding the plasmodium in the blood; whereas it in reality only explains a portion of the symptoms. Judged by these criteria, malaria complicating the puerperium will occur far less frequently than is at present said to be the case; but there is absolutely no doubt that it occasionally occurs, as the writer recently demonstrated in his own work. In this case we were able to demonstrate the presence of quartan malarial organisms in the blood of the patient, and at the same time to demonstrate the absolute sterility of the uterine lochia.

The diagnosis of typhoid fever is very frequently made in the post-puerperal infections, and is based by the average observer upon the long-continued fever and the general prostration of the patient. The writer, while he believes that in rare instances typhoid fever may complicate the puerperium, as well as any other condition, is confident that only a small proportion of the cases which are thus designated are really typhoid in origin, but that most of them depend upon the uterine infection. And in the present state of our knowledge, especially since Widal's discovery of the agglutinative action of the blood serum of typhoid patients upon cultures of typhoid bacilli, we are not justified in making a diagnosis of typhoid fever unless this specific action can be demonstrated. And we might say that every rise of temperature during the puerperium should be regarded as due to infection unless we can clearly demonstrate some other affection to be its cause. Occasionally typhoid fever occurring in the puerperium may so simulate an infection that a diagnosis of puerperal fever will be made. Jung has recently described several cases in which the mistake was made, the true nature of the malady not being recognized until autopsy.

Therefore, in making a diagnosis of any affection complicating the puerperium, an accurate and complete physical examination of the patient is necessary, and it should be combined with all the aids which the recent advances in microscopy and bacteriology have placed at our command.

As we have already stated, the most common form of puerperal infection is an endometritis, which is either of the putrid or septic variety, and it is a matter of the greatest possible importance to decide with which we have to deal. In many cases the clinical symptoms will indicate with tolerable accuracy whether we have to deal with a sapræmic or septic condition; but the only method by which we can arrive at a positive conclusion is by taking cultures from the interior of the uterus, when we will obtain putrefactive organisms in the sapræmic form, and the pyogenic organisms, and especially the streptococcus, in the septic forms. When the infection is due to the gonococcus, the development urulent ophthalmia on the part of the child affords a ready method gnosis. But even in such cases one is not sure that it is the only ism concerned.

FIG. 359.

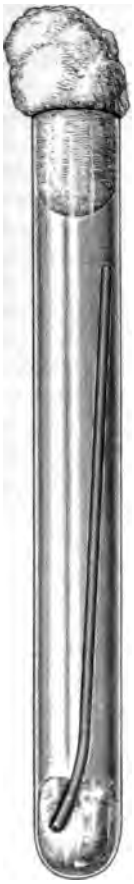


FIG. 360.

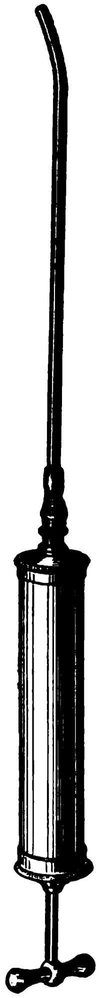
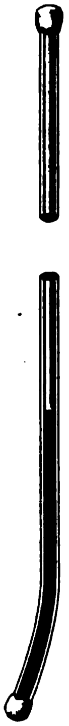


FIG. 361.



ltures may be taken from the interior of the uterus with compara- little difficulty by means of the lochial tube, which was first intro- by Doederlein,[1] and which consists of a glass tube 20 to 25 cm. in and 3 to 4 mm. in diameter, with a slight bend at one end so as to rm to the anteflexed condition of the uterus. It is sterilized either y heat or steam, and is then ready for introduction. In practice ost convenient method for sterilizing the tube and enabling us

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derlein. Untersuchung über das Vorkomen von Spaltpilzen in den Lochien des Uterus und ina gesunder und kranker Wochnerrinnen. Arch. f. Gyn., 1887, xxxi. 412.

to carry it with us in a sterile condition is to place it in a long test-tube of thick glass, which contains at its lower extremity a small amount of cotton, and whose upper end is filled by a cotton plug, just as one closes the ordinary culture tubes which are employed in bacteriology. The lochial tube is then sterilized within the test-tube, and may thus be carried from place to place without fear of contamination.

When we wish to make cultures from the uterus, our hands and the external genitalia should be thoroughly disinfected, the patient placed in Sims's position, and a sterilized Sims's or Simon's speculum introduced so as to retract the posterior vaginal wall, then the cervix caught with a sterile volsellum forceps and brought down to the vulva. Its vaginal portion is then carefully cleansed with a bit of sterilized cotton, and the sterile lochial tube is removed from its container and introduced into the uterus as high up as it will go, care being taken to avoid touching the external genitals in the operation. To the end of the tube, which protrudes from the vulva, a syringe, which draws well, is attached by means of a rubber tube. Suction is made, whereby a certain amount of the uterine contents is drawn up into the tube. The tube is then removed and its ends sealed with sealing wax and replaced in its container, when it can be carried without fear of contamination. On reaching the laboratory it is broken in its middle portion and cultures taken from its contents. Fig. 359 shows the lochial tube within its test-tube, Fig. 360 the tube ready for use, with the syringe attached, and Fig. 361 the tube sealed and ready for transportation to the laboratory.

While this method appears somewhat complicated, it can readily be carried out by any one who is conversant with the ordinary rules of surgical technique, and the tube then sent to the laboratory for examination. By this means we are able within twenty-four hours to know with certainty whether our infection is due to sapræmic or pyogenic organisms, and whether we have to deal with a comparatively harmless or a dangerous affection.

Marmorek[1] in his article on the anti-streptococcus serum strongly urges the bacteriological examination in every case of puerperal infection. The writer makes it a part of the routine examination in every case presenting a rise of temperature above 101°, and the satisfaction of knowing exactly with what form of infection he may have to deal amply repays him for the trouble taken, and at the same time gives him important indications as to treatment.

Pinard,[2] in his recent work on puerperal infection, scoffs at the idea of bacteriological examinations in puerperal fever, and states that "they are beyond the scope of any except trained bacteriologists." But the writer's personal experience is opposed to this; and he believes that this method of diagnosis can be adopted by any one who knows how to disinfect his hands and who lives within reach of a competent bacteriologist.

Just after removing the lochia by the lochial tube it is the writer's practice, provided the cervix is sufficiently patulous, to introduce his sterile finger into the uterus and feel its interior, after which a douche of several litres of natural salt solution should be given. This procedure gives us very important information, and enables us in many cases to predict in advance the result of the bacteriological examination, and gives us important information as to the line of treatment to be pursued.

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[1] Marmorek. Le streptocoque et le sérum antistreptococcique. Annales de l'Inst. Pasteur, 1895, ix. 593–620.

[2] Pinard and Wallich. Traitement de l'infection puérpérale. Paris, 1896.

In the vast majority of cases in which we have to deal with putrid endometritis and those forms due to the colon bacillus, we usually find the surface of the uterus rough and covered by shreds of broken-down tissue; while in the septic forms of endometritis, and especially those due to virulent streptococci, the interior of the uterus is frequently perfectly smooth.

The mere inspection of the lochial discharge is also of considerable value, for in the cases of putrid endometritis it is frothy and frequently very offensive in odor, while in the cases of pure streptococcus infection it is very little changed from the normal. This distinction is of importance, because the first question which the practitioner usually asks of the nurse, in the presence of fever in the puerperium, is whether the lochia are foul-smelling or not, and, if he receive a negative answer, he feels fairly sure that the fever is of other than uterine origin; whereas almost the reverse is true, and, as a rule, the fouler the odor, the less is the danger to which the patient is exposed, and *vice versa.*

When the process has extended beyond the uterus, the diagnosis is much more readily made, and with the exception of malaria, typhoid, and acute miliary tuberculosis, no one can mistake the symptoms produced by a peritonitis or by a pyæmia. In the cases of parametritis and suppurative affections of the tubes and ovaries, the vaginal examination will demonstrate the presence of a tumor mass on one or the other side of the uterus, if the tumor has not already made itself evident to abdominal palpation.

Treatment. PREVENTIVE. In considering the treatment of puerperal fever, prophylaxis should occupy the most important place. As has been repeatedly pointed out in the course of this article, puerperal infection is wound-infection, and is due to the introduction of pathogenic micro-organisms by the hands or instruments of the doctor or nurse. Therefore, the most scrupulous asepsis during the conduct of labor is the means upon which we have to rely to limit its occurrence. Every physician who conducts a labor case should strongly feel his personal responsibility in this connection, and he does not do his full duty to his patient unless he regards the rules of asepsis as carefully as when performing a capital surgical operation.

The first point, therefore, in the prophylaxis of puerperal infection is the consideration of the preparation of the patient and the disinfection of the hands and instruments of the accoucheur.

At the onset of labor the patient should receive a full bath and a rectal enema. And before each and every vaginal examination the external genitals, and especially the region about the perineum and anus, should be most scrupulously washed with soap and hot water and then rinsed in 1:1000 bichloride solution, after which a pledget of absorbent cotton or a towel soaked in the same solution should be placed over the vulva and allowed to remain there until the physician is ready to make the examination, remaining in place for at least three minutes. If an operative procedure is to be undertaken the buttocks of the patient should be placed upon sterilized towels or sheets, and the legs of the patient enveloped in the same manner, so as to avoid the possibility of contaminating the hands by organisms adhering to the bedclothes or clothing of the patient. If sterilized towels are not at hand, freshly washed towels taken directly from the drawer should be used.

The best method of hand-disinfection has for a long time been a matter of dispute, and observers have not yet agreed as to the most practicable means of rendering the hands sterile. It may, however, be definitely stated that any method which will render the hands sterile, or even comparatively so, will require at least ten minutes.

The rapid method of hand-disinfection which was introduced by Fürbringer,[1] by which, it was stated, the hands could be rendered absolutely sterile in three minutes, has been shown by later experiments to be absolutely inefficient. And the rapid method of hand-disinfection by means of alcohol, which was introduced by Reinicke[2] in Zweifel's clinic in Leipsic, has been shown, by the careful work of Menge and Krönig, to be based upon a fallacy, as they showed that the alcohol did not possess a markedly germicidal action, but simply produced conditions in the skin which for the time being rendered it difficult to remove the organisms from the surface of the hands.

At the present time the best method of hand-disinfection with which the writer is familiar is the one introduced by Dr. Halsted at the Johns Hopkins Hospital some years ago, and described by Dr. Kelly.[3]

Bacteriological examination shows that it is capable of yielding better results than any other method, though in a certain number of cases it fails to produce absolutely sterile hands. The following directions are copied from the regulations for hand-disinfection which are posted over every wash-basin in the lying-in ward of Johns Hopkins Hospital:

1. Cut the finger-nails with clippers or scissors to 1 mm. in length.

2. Scrub the hands and forearms up to the elbows vigorously with nail-brush, green soap, and hot water for at least five minutes by the clock, or until they are macroscopically clean, paying especial attention to the nails and palmar surface of fingers. The water must be changed at least once. After changing it, remove dirt from beneath the nails with nail cleaner or penknife, and then renew the washing.

3. Rinse the hands in fresh water, soak then in a hot saturated solution of potassium permanganate until they take on a deep mahogany-brown color.

4. Dissolve this off in a hot saturated solution of oxalic acid.

5. Then soak the hands and forearms in a 1 : 1000 bichloride solution for three minutes by the clock.

6. Touch nothing until ready to examine the patient, going directly from the bichloride solution to her.

The only objections which can be made to this method of hand-disinfection are the length of time which it requires and the roughness of the hands which is sometimes produced by it. The first objection cannot be overcome, as the writer does not believe any one can thoroughly disinfect his hands in less than ten minutes, whether one uses permanganate and oxalic acid or not. The second objection can be obviated to a considerable extent by anointing the hands with a glycerin ointment after the examination is made. As we know that even the most vigorous methods of hand-disinfection do not render the hands absolutely sterile, it has been suggested that this object may be attained by the use of thin rubber gloves. For this purpose the gloves are thoroughly boiled and then drawn over the carefully disinfected hands; and as long as they remain intact we are certain that bacteria which are upon the hands cannot lead to infection of the patient. The gloves, however, interfere considerably with the sense of touch, and therefore we do not recommend their employment, except when we are not sure as to the condition of our hands. They should always be worn when the hands have recently come in contact with pus or infectious wound secretions.

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[1] Fürbringer. Untersuchungen und Vorschriften über die Desinfection der Hände des Arztes nebst Bemerkungen über den bakteriologischen Charakter des Nagelschmutzes. Wiesbaden, 1888.

[2] Reinicke. Bakteriologische Untersuchungen über die Desinfection der Hände. Arch. f. Gyn., 1895, xlix. 515-558.

[3] Kelly. Hand Disinfection. Amer. Journ. Obst., 1891, xxiv. No. 12.

As long as vaginal examinations are made, no matter how carefully we have attempted to disinfect our hands, infection will occasionally occur. This is due partly to the fact that hand-disinfection under some circumstances is much more difficult than is generally believed and partly to the unwitting contamination of our hands before making the examination. In many cases, even when gloves are used, bacteria may be carried from the vulva into the vagina by the examining finger, as is clearly shown by the experiments of the writer, which were mentioned in considering auto-infection. Therefore vaginal examinations should be limited in number as much as possible, and in normal cases one or two are all that is necessary, if the accoucheur is acquainted with the methods of external examination.

In a large number of cases, labor can be conducted with absolute safety and ease by means of external manipulations alone, without a single vaginal examination. And the writer believes that the only value of the latter during labor is to ascertain the degree of dilatation of the cervix and to estimate the probable duration of labor. All other points for which we seek information by vaginal examination are made out far more clearly by the external examination, and were we to be debarred from one or other form of examination, we would prefer to give up the vaginal.

The recent articles of Leopold and Spörling,[1] and Leopold and Orb,[2] show the extreme accuracy of external examination, and they state that it is possible from their own experience to deliver at least 90 per cent. of all cases by means of the external examination. Their observations show that the number of errors in diagnosis become more and more infrequent as the obstetrician becomes better trained in this mode of examination; for example, in the first 1000 cases which they delivered by this means there were 6.5 per cent. of errors of diagnosis, whereas in the last 1000 cases the errors were reduced to 1.77 per cent.

This clearly shows us what can be accomplished by external examination alone, and its importance cannot be too strongly urged upon the accoucheur. It is perfectly harmless, and cannot offend the sense of modesty of the patient, and can be employed as often as desired, and, unlike digital examination, does not require the laborious hand-disinfection. This method of examination should always be employed to the exclusion of the vaginal examination whenever the vaginal secretion presents an abnormal appearance which leads us to suppose that it contains pathogenic micro-organisms. But still more important is its employment in cases when the accoucheur is not sure of the cleanliness of his own hands, as after intra-uterine manipulations with puerperal sepsis and the performance of autopsies upon septic cases, etc. Under such circumstances the vaginal examination should be resorted to only in case some marked complication arise during the course of labor.

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[1] Leopold and Spörling. Die Leitung der regelmässigen Geburten nur durch äusseren Untersuchungen. Arch. f. Gyn., xlv. 339-371.

[2] Leopold and Orb. Die Leitung ganz normaler Geburten nur durch äussere Untersuchung. Arch. f. Gyn., 1895, xlviii. 304-323.

In view of what has already been stated concerning the bacterial contents of the vagina, and the result of experiments by Leopold[1] and others with the prophylactic vaginal douche, and also as the result of his own personal experience, the writer strongly advises that the prophylactic douche be not employed as a matter of routine, but that it be resorted to only when the vaginal secretion presents marked evidences of abnormality.

All that has been said concerning the necessity of cleanliness and asepsis on the part of the physician applies equally well to the nurse, and she should be strictly forbidden to make vaginal examinations or give douches except at the direct request of the physician in charge; otherwise, we have no means of knowing, in case infection ensues, whether it is the result of our own carelessness or not.

During the second stage of labor it is well to have the vulva covered by an aseptic pad, in the form of a towel soaked in bichloride solution. This is done not so much for fear of infection from the air as to prevent the possibility of the patient contaminating herself with her hands.

The third stage of labor likewise offers many facilities for infection, and too much stress cannot be laid upon its proper conduct; and, generally speaking, the generative tract, after the birth of the child, should be regarded as a *noli me tangere,* except in cases of urgent necessity.

Excepting severe hemorrhage and cases of adherent placenta, there is absolutely no indication for introducing the hand into the parturient tract. I believe that the frequency of adherent placenta is very grossly over-estimated, and in many cases its occurrence is due to the injudicious employment of Credé's method. The writer's practice is to watch the fundus of the uterus by placing his hand gently upon it, but not kneading it. After the lapse of ten or fifteen minutes, as a rule, we notice that the fundus rises about 5 cm. toward the umbilicus; this means that the placenta has been detached from the uterine wall and has been expelled either into the lower uterine segment or into the vagina. Under these circumstances it is ready for expression, the body of the uterus being simply used as a piston to force the detached placenta through the vagina.

If after waiting half an hour the fundus uteri does not rise up, as described, we should then resort to the typical Credé method of expression. Observance of these directions will show that adherent placenta is of very rare occurrence, indeed, and will not necessitate the introduction of the hand in utero more than once in several hundred cases.

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[1] Leopold. Vergleichende Untersuchungen über die Entbehrlichkeit der Scheidenausspülungen bei ganz normalen Geburten und über die sogenannte Selbstinfektion. Arch. f. Gyn., 1894, xlvii. 580–635.

The practice recommended by Grandin,[1] Palmer Dudley,[2] and others, who advocate routine vaginal examination at the conclusion of the third stage of labor, to detect cervical tears, which they believe should be repaired immediately, cannot be too strongly deprecated, and those who follow their advice will surely find that a much larger proportion of their patients present abnormal puerperia than if they reserved the vaginal examination at the conclusion of the third stage of labor for exceptional and urgent cases.

Another point in the prophylaxis of puerperal infection is attention to perineal tears, and every tear which extends deeper than the mucosa should be sutured immediately after the conclusion of labor, unless it be contraindicated by the general condition of the patient or by a very œdematous condition of the parts. To save time, it is the writer's practice to introduce the sutures immediately after the birth of the child and while waiting for the expulsion of the placenta. Their ends are then grasped by artery-forceps and are tied as soon as the placenta has been expelled. This method, beside saving considerable time, is also beneficial in that it gives us something to do during the third stage of labor, and does not so often expose us to the temptation of premature expression of the placenta.

After the third stage is ended the patient should be cleaned and dressed with an aseptic vulval pad, which is held in place by a T-bandage.

During the puerperium the external generative organs should be frequently cleansed with a 1:2000 or 1 : 4000 bichloride solution applied by means of an irrigator or on small pieces of cotton. The writer strongly deprecates the routine use of douches during the puerperium, and considers that they should be given only under exceptional circumstances, and when employed should be given by the doctor himself, unless he has a nurse who is thoroughly versed in aseptic technique and upon whom he feels he can confidently rely. In several cases the writer has seen infection in the later periods of the puerperium follow the use of dirty syringes in the hands of a nurse.

CURATIVE. When we come to the consideration of the curative treatment of puerperal sepsis we have to deal with a question about which there is still a great deal of dispute, and what we shall say will probably stand in marked contrast to much of the current practice in this regard. If we find a puerperal ulcer about the perineum or lower portion of the vagina, the parts should be kept as clean as possible, and the ulcer occasionally touched with 50 per cent. carbolic acid or tincture of iodine. If the perineum has been repaired and its edges are suppurating, we should remove the stitches so as to obtain free drainage.

Puerperal endometritis is the affection which we are called upon most frequently to treat, and it is here that the directions for treatment differ so greatly.

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[1] Grandin. Late Infection in the Puerperal State; being a plea for the routine manual examination of the interior of the uterus after the completion of the third stage of labor. Trans. Amer. Gyn. Soc., 1895. xx. 462–468.

[2] Dudley. Immediate Repair of Lacerated Cervix. Trans. Amer. Gyn. Soc., 1895, xx. 343.

As soon as our patient's temperature reaches 102° or 102.5°, unless we can certainly exclude uterine infection, we should investigate the uterus. The hand should be carefully sterilized and, as indicated when considering the diagnosis of the affection, a certain amount of the lochia should be removed from the uterus for bacteriological examination, after which the sterilized index finger should be introduced into the uterine cavity, and its interior carefully palpated. Then a careful bimanual examination should be made to ascertain the condition of the appendages and the broad ligaments. If we find the uterine cavity perfectly smooth and not covered with shreds of broken-down tissue, we should give a douche of several litres of boiled water or normal salt solution, but should not think of curetting. On the other hand, if we find the interior of the uterus rough and jagged and containing more or less débris, it should be thoroughly cleaned out with the finger, followed by the curette, if necessary, after which the saline douche should be employed. The employment of the curette is not to be recommended in all cases of puerperal endometritis, for the reason that in many instances, and these are usually the most severe cases, there is absolutely nothing which can be removed by it, and its employment can only do harm by breaking down the leucocytic wall which is intended to prevent the ingress of organisms into the deeper layers of the uterus. If, however, the uterus contains débris, its removal by the finger or curette is indicated.

The routine employment of the curette in all cases of puerperal infection is advocated by most of the French and American writers. Pinard[1] and Doléris[2] are particularly enthusiastic in this regard; while the Germans, on the other hand, reserve its use for exceptional cases, Fritsch's[3] views representing the usual German doctrines on this subject.

It will be noticed that nothing has been said about the employment of antiseptic douches in the treatment of puerperal endometritis. The writer regards the routine use of bichloride or carbolic injections in the treatment of these cases as productive of more harm than good. If we have to deal with septic endometritis produced by a virulent streptococcus, microscopical examination shows us that the organisms have penetrated far into the uterine wall by the time we get the initial chill and rise of temperature. Under these circumstances the employment of an antiseptic douche is not rational, as we know that it cannot reach the organisms in the uterine wall, which are giving rise to the symptoms and upon which the further spread of the disease is dependent.

It has been shown experimentally by Bumm[4] that bichloride injections penetrate the tissues to only a very slight extent. He took the liver of an animal dead of anthrax, soaked it for thirty minutes in a 1:1000 bichloride solution, then placed it upon a freezing microtome and cut thick sections from it. After cutting off about $\frac{1}{10}$ mm. he inoculated the next section into another animal, and found that it died from anthrax, thus showing that the antiseptic action of the bichloride was exerted only upon the surface of the tissues. If this be the case in the laboratory, where the tissues are soaked in a bichloride solution for some time, what effect upon organisms lying in the muscle wall of the uterus can we expect from the passage of a few litres of bichloride solution through its cavity?

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[1] Pinard and Wallich. Traitement de l'infection puérpérale. Paris, 1896.

[2] Doléris. Curettage dans le sepsis puérpéral. Nouv. Archives d'Obst. et de Gyn., Mai, Juin, 1886, Fev. Mars, 1887.

[3] Fritsch. Ueber Auskratzung des Uterus nach reifer Gebhrten. Zeit. f. Geb u. Gyn., 1891, xxi. 456.

[4] Bumm. Ueber die verschiedenen Ferulenzgrade der puerperalen Infektion und die lokale Behandlung bei Puerperalfieber. Cent. f. Gyn., 1893, 975.

[5] Bumm. Op. cit.

Bumm[1] likewise showed that the streptococci made their way through the uterus with great rapidity, and after infection in animals found that streptococci could travel 2 cm. or more in the space of six hours. What has been said concerning bichloride applies equally well to the other disinfectants.

Now, when we come to consider their employment in cases of putrid endometritis, we shall find it even less rational than before. In the vast majority of such cases simply cleaning out the uterus with the finger or curette will lead to a rapid fall of temperature and the amelioration of symptoms. Our object in giving douches in most of these cases is simply to wash away débris which has been left behind by the curette or finger, and for this purpose sterile water is far better than any antiseptic fluid. The writer's results from this method of treatment are as good as those obtained by others who use the various antiseptic douches. In this opinion he is sustained by most of the men who have done bacteriological work in this connection, notably Bumm[2] and Krönig.[3] The writer has treated 52 cases of streptococcic endometritis, with 2 deaths attributable to the disease, a mortality of less than 4 per cent. In 30 cases he had to deal with a pure streptococcic infection, and none of the cases died; while in 12 cases the streptococcus was associated with the colon bacillus or other organisms, and 2 of the patients died. These results apparently bear out the conclusions of Bar and Tissier, that combined infection with the streptococcus and colon bacillus are much more dangerous than infections due to either organism alone. At the same time we do not desire to give the impression that pure streptococcic infections are not serious. For it is not the case, as they are a very frequent cause of death, and we are sure that we shall eventually have to report fatal cases. But we feel that our results plead eloquently for the treatment which we have outlined, and appear to indicate that the lives of many infected women have been sacrificed by too energetic treatment.

In addition to these somewhat theoretical objections to the employment of antiseptics in the treatment of these affections, there is the very practical one that they are far from harmless. Any one who is conversant with the literature on the subject will recall the cases of sudden collapse following the use of carbolic-acid douches, while the employment of bichloride douches is sometimes the direct cause of death. Several years ago, the writer did an autopsy upon a woman supposed to be dead from puerperal sepsis, but he found all the anatomical lesions of bichloride poisoning, and it was at least doubtful whether the sepsis or the treatment instituted for its relief had caused her death.

In looking over the literature after this case, some 46 cases were found in which death had followed the employment of bichloride douches during the puerperium. In many instances death was clearly due to the employment of overlarge quantities of bichloride; but in several cases a single injection of several litres of a 1:4000 bichloride solution resulted in the death of the patient from mercurial poisoning.

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[1] Bumm. Op. cit.

[2] Bumm. Op. cit.

[3] Krönig. Aetiologie und Therapie der puerperal. Endometritis. Cent. f. Gyn., 1895, 422, 432. Discussion über Endometritis. Verh. de deutschen Ges. f. Gyn., 1895, 498–502.

When we take these facts into consideration, along with the theoretical objections to the employment of antiseptics under these circumstances, it would appear that the benefit to be expected from their employment is at least very problematical.

To recapitulate, we would say that in puerperal endometritis, after having removed lochia for cultures, the interior of the uterus should be explored by the sterile finger, and cleaned out or not according to its condition. The uterus should then be douched with several litres of boiled water or sterile salt solution. If the bacteriological examination shows the presence of streptococci, we should at once desist from all further local treatment. If, on the other hand, we have to deal with a putrid endometritis, and the symptoms do not yield to the first injection, still other injections may be resorted to. If the infection has extended beyond the uterus, local treatment should not be persisted in, as it will then do more harm than good.

Bumm[1] pointed out in his article on puerperal endometritis that in many instances involution had taken place very incompletely, and he, therefore, recommended the employment of ergot to secure better contraction, and thereby occlude to a greater or less degree the lymphatics in the uterine wall. My own experience confirms Bumm's[2] statements, and I would, therefore, earnestly recommend the employment of the drug in cases in which the uterus is larger than it should be at a given period of the puerperium.

In the cases of gonorrhœal endometritis very little, if any, active treatment is required at the time, for in the vast majority of cases the slight rise of temperature which is noticed at the onset of the disease soon falls to normal, and our patients recover spontaneously or are left with a chronic endometritis, which can be treated much more advantageously at a later period.

Schücking[3] some years ago recommended the continual irrigation of the uterine cavity with antiseptic solutions. His results, however, were not appreciably better than those obtained by others who used only the intermittent douche, and his methods of treatment never came into very widespread employment. With the French, however, the method has found warm supporters, and is at the present time employed by Pinard[4] in almost every case of infection.

If the method of treatment above outlined does not lead to an amelioration in the condition of the patient, all local treatment should be desisted from, and we should place our reliance upon general tonic treatment. Our most potent remedies in this regard are strychnine and alcohol, and it has been shown by Runge[5] that women in this condition can bear much larger quantities of alcohol than when in health. The fever should not be treated with antipyretics, and if we feel that it should be abated, we may attempt it by the local application of cold, either in the form of sponges or cold baths. This method of treatment has been enthusiastically advocated by Macé,[1] Runge,[2] and Desternes,[3] and according to them has given very satisfactory results. If the process has extended beyond the uterus, and we have to deal with a parametritis or a pelvic peritonitis, the application of heat to the lower portion of the abdomen, either in the form of poultices or other hot applications, is to be recommended.

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[1] Bumm. Histologische Untersuchungen über diepuerperal. Endometritis. Arch. f. Gyn., 1891, xl. 398.

[2] Bumm. Op. cit.

[3] Schücking. Quoted by Kehrer. Müller's Handbuch der Geb., 1889, iii. 343.

[4] Pinard and Wallich. Traitement de l'infection puérpérale. Paris, 1896.

[5] Runge. Die Allgemeinbehandlung der Puerperalen Sepsis. Vierte Mittheilung, 1888, xxxiii. 39-52.

Occasionally, surprisingly good results are obtained in cases of profound septication by the repeated subcutaneous injection of sterile salt solution. Attention was first directed to this means of treatment by Bosc,[4] and subsequent investigations have in great part justified his predictions.

Of late a great deal has been written on the operative treatment of puerperal infection, nearly every prominent obstetrician and gynecologist in the country having made some contribution in this direction. Every one is agreed as to the advisability of opening parametritic abscesses as soon as fluctuation appears, rather than allowing them to rupture spontaneously. In many cases of parametritis we may obtain on palpation a semi-fluctuation, which will lead us to suppose that we have to deal with pus, but upon opening the supposed abscess through the vagina or abdominal wall, as the case may be, we find that our tumor is a mass of inflammatory exudate without pus-formation, and only a small amount of serous fluid will escape when it is excised. The incision of these masses frequently leads to as good results as though we had evacuated a considerable quantity of pus, just as we obtain excellent results from free incisions in ordinary cases of cellulitis in other portions of the body.

When we are able to demonstrate the presence of pus tubes or ovarian abscesses by bimanual palpation, their removal is urgently indicated, for as long as they remain our patient will continue in her septic condition.

Whether we remove the pus tubes by laparotomy or puncture them through the vagina will depend upon their character. If freely movable, laparotomy should be performed; while, on the other hand, if adherent and readily accessible from the vagina, vaginal puncture with subsequent packing of the abscess cavity with gauze is to be preferred.

The operations of which we have just spoken are usually not performed until the latter part of the puerperium, because it is not until then that definite tumor masses can be made out.

The chief discussion concerning the operative treatment of puerperal infection has been as to the advisability of removing the infected uterus at an early period. Here the various observers take quite opposite views, the more radical surgeons advocating the early removal of the uterus, while the more conservative men do not regard it with great favor.

It would appear to me that in the vast majority of cases hysterectomy in the early stages of puerperal infection is impracticable, for if we operate at a period sufficiently early to prevent the extension of the process to other organs, we shall undoubtedly remove a large number of uteri unnecessarily; whereas, if we wait until a later period, when other organs have been involved, the operation will likewise be useless. There is, however, a restricted field for hysterectomy in puerperal infection, for in a certain number of cases we find that the process has not extended materially beyond the uterus, but has given rise to abscess formation within its walls. In such cases, if more conservative treatment fails, we should not hesitate to remove the entire organ. Occasionally in rare cases of putrid endometritis nothing that we can do appears to check the disease, and in these cases also operation would appear justified. Such a case has been reported by Sippel,[1] in which, after the total failure of all other methods of treatment, hysterectomy resulted in the cure of the patient.

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[1] Macé. Traitement de la sépticémia puérpérale par la réfrigération et en particulier par les bains froids. Gaz. des hôp., 1894, 1367–1372.

[2] Runge. Op. cit.

[3] Desternes. Indications et rôle du bain froid dans le traitement de l'infection puérpérale. Thèse de Paris, 1895.

[4] Bosc. Injections de sérum artificiel dans les maladies infectieuses et les intoxication. Presse méd., 1896, No. 49, pp. 287–290.

In a recent article Lusk[2] stated that there is probably a field for hysterectomy in certain cases of uterine thrombosis when infected thrombi are carried off to various portions of the body, giving rise to a hectic condition. He declares that when this is observed, if the operation be done after, say, the second rise of temperature, it offers a very reasonable chance of success. No doubt in a small number of cases this may be true; but in the majority of cases the thrombosis has extended far beyond the uterus when the pyæmic symptoms make their appearance, and we would be obliged to operate through septic tissue. On the whole, the question of hysterectomy in this affection seems to depend altogether upon our ability to make a correct diagnosis and to foretell the course of the disease. This is a matter of great difficulty, and until more accurate means of diagnosis are at our disposal we do not believe that the operation will be very generally accepted.

The prospects of coping more successfully with puerperal infection were greatly brightened in 1895 by Marmorek's[3] announcement that he had discovered an antistreptococcic serum. In February of that year he stated before the Biological Society of Paris that he was able, by growing streptococci in a mixture of human blood-serum and agar, and repeatedly inoculating animals with them, so to increase their virulence as to obtain a culture so virulent that the one-hundred-billionth part of a cubic centimetre of it would kill a rabbit in thirty hours. By injecting this very virulent culture into immune animals he was able to produce what he considered a preventive and curative serum. At the same meeting Charrin and Roger[4] stated that they had likewise prepared a serum by the injection of sterile cultures of streptococci into the lower animals, and reported 2 cases of puerperal infection which they had successfully treated with it at the Paris Maternity.

In July, 1895, Marmorek[5] published a long article in the *Annales de l'Institut Pasteur*, in which he described his method of preparing the serum, and gave the results of its employment in 413 cases of erysipelas and 16 cases of puerperal infection. In all of the latter cases the uterine lochia were examined bacteriologically, and he found that he had to deal with a pure streptococcic infection in 7 cases, all of which recovered. When the streptococcus was combined with other organisms the results were not so favorable, and 5 of the 9 cases of this character ended fatally. Since then antistreptococcic serum has been largely employed in all parts of the world in the treatment of puerperal infection, but, as far as the writer can see, with very unsatisfactory results.

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[1] Sippel. Supravaginale Amputation des septischen puerperalen Uterus Cent. f. Gyn., 1894, 667-74.

[2] Lusk. Recent Bacteriological Investigations Concerning the Nature of Puerperal Fever. Amer. Journ. Obst., 1896, xxxiii. 337-347.

[3] Marmorek. Sur le streptocoque. Comptes rend. de la Soc. de Biol., 1895, x. série, ii. 122.

[4] Charrin and Roger. Essai d'application de la sérum-therapie au treatment de la fièvre puerpérale. Comptes rend. de la Soc. de Biol., 1895, x. série, ii. 234.

[5] Marmorek. Le streptocoque et le sérum antistreptoccique. Annales de l'Institut Pasteur, 1895, ix. 593-620.

In May, 1899, a committee of the American Gynecological Society, of which the writer was chairman, made an exhaustive report[1] upon this subject, and collected all the cases treated by serum which had been reported up to that time, and gave the complete literature upon the subject. They found that 352 cases of puerperal infection had been so treated, with 73 deaths, a mortality of 20.74 per cent. In a large number of cases the lochia were not examined bacteriologically, and there was therefore considerable doubt as to whether the infections were due to the streptococcus; but in 101 cases in which its presence was demonstrated there were 33 deaths, a mortality of 32.69 per cent. This was a very discouraging showing, especially when compared with the results obtained by Krönig[2] and the writer without its use, as the former has treated 56 and the latter 52 cases of streptococcus endometritis, with a mortality of less than 4 per cent. The question therefore arises, Was the high mortality attending the use of the antistreptococcic serum due to its employment or to other causes? Our investigations indicated that the antistreptococcic serum was practically harmless, and therefore the poor results attending its use could not be attributed to its employment. But they can probably be explained in two ways: First, that only exceptionally severe cases were treated by it; and secondly, that a large number of the cases so treated were in the hands of French observers, who curette the infected uterus as a matter of routine, and we have already referred to the serious effect of such a procedure. In view of these facts, the committee reported that there was no evidence of the curative value of antistreptococcic serum in the treatment of puerperal infection; but at the same time the serum did not exert a deleterious effect upon the patient, and therefore might be employed if the physician so desired.

These conclusions stand in marked contrast to the enthusiastic reports of many observers, and we are inclined to attribute the good results of individual practitioners to the fact that they employed the serum in only a few cases, and lost sight of the fact that most cases undergo spontaneous cure, if not interfered with.

It is very difficult to arrive at correct conclusions as to the value of therapeutic agents in the treatment of this affection unless large numbers of cases are used as a basis, for the reason that its clinical course is very variable. It is not at all infrequent, in cases of streptococcic infection, to see the temperature rise rapidly to 103°–105° F., remain there for several days, and then fall as rapidly as it had risen. In many cases this occurs without the employment of any treatment, and had antistreptococcic serum been employed in such cases it is more than probable that the rapid amelioration of symptoms would have been attributed to its use. Such cases illustrate the necessity for extreme caution in expressing an opinion as to the value of any method of treatment, and we consider that correct ideas can only be arrived at by a careful and systematic observation of a large number of cases in the hands of a single observer.

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[1] Williams, Pryor, Fry, and Reynolds. The Value of Antistreptococcic Serum in the Treatment of Puerperal Infection. Trans. Amer. Gyn. Soc., 1899, xxiv. 80-126.

[2] Krönig. Bakteriologie des Genitalkanales der schwangeren, kreissenden u. puerperalen Frau. Leipzig, 1897.

That none of the methods advocated for the treatment of puerperal infection are wholly satisfactory is indicated by the number of methods of treatment which have been from time to time advanced, and only a few of the more recent methods will be referred to.

Thus, Fochier[1] advocates in pyæmic cases the production of what he calls "abscess de fixation"—that is, the production of abscesses on various portions of the body by the subcutaneous injection of turpentine; he states that he has observed in numerous cases of pyæmia that the condition of the patient improved as soon as abscesses made their appearance on the surface, and in his method of treatment he attempts to simulate nature. This method has found few followers, and does not give promise of any great results.

Kezmarezky[2] in 1894 reported two cases of severe venous sepsis in which he had given intravenous injections of 1 to 5 mg. of sublimate. He stated that in both cases a marked effect was apparent, and that both recovered. His work was enthusiastically taken up by Rissmann,[3] who likewise reported several cures from its employment. But it does not appear that this method of treatment will find many imitators.

Another method of treatment was introduced by Hofbauer[4] in 1896, who reported seven cases of puerperal sepsis in which he produced an artificial leucocytosis by the employment of nuclein. In some of his cases the temperature fell by a lysis and in others by crisis, and he believed that the artificial leucocytosis played a marked part in their cure. Thus far no one has substantiated his results, but Hirst[5] in a recent article states that he believes that more is to be expected from this line of treatment than from serum-therapy.

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[1] Fochier. Traitement de l'infection puérpérale par la provocation de phlegmons sous-cutanés. Ann. de Gyn., 1892, xxvii. 356–362.

[2] Kezmarezky. Intravenöse Sublimatinjection (Bacelli) bei venöser Sepsis im Wochenbette. Cent. f. Gyn., 1894, 906.

[3] Rissmann. Intravenöse Sublimatinjectionen bei Puerperalfieber. Frauenarzt, 1895, i. 240-244.

[4] Hofbauer. Zur Verwerthung einer künstlichen Leukocytose bei der Behandlung septischen Puerperalprocesse. Cent. f. Gyn., 1896, 441–449.

[5] Hirst. Modern Methods in the Treatment of Puerperal Infection, and their Comparative Worth. Amer. Journ. Obst., 1896, xxxiv. 180-184.

CHAPTER XXVIII.

MALFORMATIONS, INJURIES, AND DISEASES OF THE NEW-BORN CHILD.

Malformations.

Meningocele and Encephalocele. Owing to a congenital opening at some part of the skull, some portion of the cranial contents may protrude. The defect is most common in the occipital bone, in any portion of which the defect may be present, from the peripheral part to the centre. If it exists in the anterior portion of the bone, it may extend to the posterior fontanelle; if in the back part, it may connect with the foramen magnum. The size of the tumor depends, of course, upon the extent of the opening in the bone. Similar defects may also be present in the naso-frontal region, and less frequently in the basilar, temporal, and parietal segments of the skull. The openings may contain meninges alone, meninges with brain matter, or the latter with fluid in the interior; in the latter event the anomaly is termed hydrencephalocele. The tumors appear at or soon after birth.

A meningocele is usually small, with little tendency to increase in size. It may be more or less pedunculated; it presents fluctuation, but no pulsation, and is usually reducible.

In encephalocele there is distinct pulsation, and efforts at compression will be accompanied with evidences of marked cerebral irritation. The tumor, though not large, has a wide base, and is partly reducible.

A hydrencephalocele is apt to be large, lobulated, with sometimes a distinct peduncle. Pulsation is usually absent in the tumor, which, however, is fluctuating and mostly translucent. Compression is not apt to be successful in reducing the tumor. Sometimes there is more brain-substance in the tumor than in the cranial cavity, and the infant is then microcephalic.

PROGNOSIS. The prognosis in hydrencephalocele is bad, as the tumor usually grows rapidly, and there may be rupture, with immediate death. In meningocele and encephalocele the prognosis is better, especially if the tumor be small.

TREATMENT. Treatment in these cases is of little avail, although the withdrawal of fluid and even stimulating injections have been tried.

Spina Bifida. Owing to congenital failure in the development of the vertebral arch, one or more of the laminæ may be absent, with resulting protrusion of the spinal meninges. The lumbar region of the spinal column is the part usually affected. Occasionally, however, we have meningocele or encephalocele. (Fig. 322.) The tumor is round, fluctuating, and by compression the cerebro-spinal fluid can be forced back into the spinal canal. Too severe pressure, however, may produce eclampsia or other grave cerebral symptoms. The base of the tumor depends upon the size of the opening, being pedunculated if it is small, but more sessile if large. The tumor is usually covered with skin, which, however, may be absent, exposing the dura mater. If there is not much tissue covering the tumor, transudation may occur through the walls, or rupture of the sac may take place if growth is rapid. Some portion of the lower segment of the cord or the cauda-equina is apt to be imprisoned in the sac. The extent of the involvement of nerve-tissue can be measured by the paraplegia or other evidences of lesion in the spinal cord and nerves.

Gradual absorption of the fluid may occur, and the child may grow up with little inconvenience from the shrivelled tumor. This, of course, takes place only when the nerves are not involved. In most cases there is a gradual increase in the size of the tumor, with final ulceration or rupture, followed by convulsions or coma and death. The fatal ending may also come with a gradual emaciation accompanying paraplegia.

TREATMENT. The treatment of small tumors consists in the application of a soft compress to avoid friction and to support the parts. When the tumor is growing, however, more energetic measures may be tried. The simplest procedure is to withdraw the fluid by aspiration, and follow this with gentle but constant pressure. The fluid must be slowly and cautiously removed, for fear of active nervous disturbance and even eclampsia. Injections with iodine of various strengths have been tried, but without much success. In some cases the tumor can be surgically removed by completely excising the sac. This may be successfully accomplished in the pedunculated variety where the opening in the lamina is small. It should never be attempted if there is evidence that the cord or cauda equina may be involved in the tumor.

Cyanosis. New-born infants sometimes exhibit a persistent blueness due to malformation of the heart. This defect usually takes the form of deficiency in the inter-auricular and inter-ventricular septa. The great vessels may likewise be involved in the malformation, especially the pulmonary artery. Dr. J. L. Smith found in over half the cases he examined by autopsy that the pulmonary artery was absent, rudimentary, impervious, or partially obstructed. He also found the following lesions: Right auriculo-ventricular orifice impervious or contracted; orifice of the pulmonary artery and the right auriculo-ventricular aperture impervious or contracted; right ventricle divided into two cavities by a supernumerary septum; one auricle and one ventricle; a single auriculo-ventricular opening, with inter-auricular and inter-ventricular septa incomplete; mitral orifice closed or contracted; aorta absent, rudimentary, impervious or partially obstructed; aortice orific and left auriculo-ventricular orifice impervious or contracted; aorta and pulmonary artery transposed, the vena cava entering the left auricle; pulmonary veins opening into the right auricle or into the vena cava or azygos veins; aorta impervious or contracted above its point of union with the ductus arteriosus; the pulmonary artery wholly or in part supplying blood to the descending aorta through the ductus arteriosus.

It is obvious that with any of these grave central lesions, not only the peripheral circulation but the nutrition as well must suffer. The blood is deficient in oxygen and has an excess of carbon dioxide. The blueness is most pronounced in the prominent parts of the face, such as the eyebrows, cheek-bones, nose, and lips. The hands and fingers are also prominently affected. The color varies from a light to a very deep purple, the discoloration being aggravated by crying or other disturbing influence.

While the infants at birth may be well developed, there are soon evidences of failure of nutrition, and they are very susceptible to intercurrent diseases. The action of the heart is rapid and tumultuous, and the respiration is correspondingly disturbed. Various bruits are heard upon auscultation of the heart. The infants suffer from lack of sufficient animal heat, and because of this and pulmonary congestion they easily contract pneumonia. Most cases do not survive the first year, but if they live longer they present a stunted appearance, with peculiar bullous fingers and toes.

All that can be done in the way of treatment is to strive to maintain the natural temperature and a fair nutrition.

Malformation of the Rectum and Anus. Bodenhamer gives the following classification of the congenital defects of these parts: (1) Congenital narrowing of the rectum or anus without complete occlusion; (2) complete occlusion of the anus by a membranous diaphragm or well-formed skin; (3) anus absent and rectum ending in a blind pouch at a point more or less distant from the perineum; (4) anus normal in appearance, but ending in a cul-de-sac, and the rectum ending in a blind pouch at a variable distance above this point; (5) anus absent and the rectum ending in a fistula opening at any point of the perineal or sacral region; (6) the anus absent, and the rectum ending in the vagina, the bladder, or the urethra; (7) the anus and rectum normal, but the ureter, vagina, or urethra opening into the rectal cavity; (8) the rectum totally absent.

The time of the passage of the first stool and its size and character should always be investigated by the attending physician. Minor degrees of stenosis of the rectum or anus are not infrequent in the newly born. Although the thin feces of infancy may escape without difficulty, when the child grows older and the excreta become more solid, stenosis may occasion much inconvenience.

TREATMENT. Congenital stenosis is best treated by gradual dilatation. A convenient bougie is the index-finger, well oiled, and daily inserted.

When a thin band of membranous tissue closes the anus, a crucial incision will open up the rectal pouch. For the graver forms of malformation, elaborate and careful operations are required, which, as they are fully treated in works on surgery, will not be considered here.

Injuries During Birth.

Excessive Moulding. In difficult labor, even though spontaneously completed, the child not infrequently suffers more or less serious injury during its passage through the birth-canal. As the head is the part of the fœtus which normally offers the greatest resistance, it is the most frequent seat of such injuries. The soft and yielding character of the skull and the moulding to which it is frequently subjected may produce marked distortion. The diameter which falls in relation with the axis of the birth-canal is elongated at the expense of the engaging diameters. The head, however, usually resumes its normal shape within a few days after birth.

Cephalhæmatoma is an effusion of blood between the bone and the periosteum covering it. It usually appears within one to three days after birth. Its seat may be any portion of the cranial vault. Most commonly it occurs in the parietal region, sometimes over the temporal or occipital bones. The overlying integument presents no discoloration. A bony ring is soon developed around the base. The effusion is, in most cases, limited by a suture. The effused blood, as a rule, undergoes absorption within the first three months of life. In rare cases suppuration ensues, and even caries of the subjacent bone may occur. The fact that the tumor does not communicate with the brain cavity, which fact can usually be readily made out by palpation, serves to distinguish this affection from encephalocele.

TREATMENT. In most cases no treatment is called for. Should the tumor grow it may be strapped with adhesive plaster, the head first being shaved. Incision, while generally condemned, has been practised with success. It offers the advantage of immediate relief, and leaves no permanent deformity. The effused blood can usually be removed through a small opening. A firm compress is worn for several days to prevent refilling. It is needless to say that the strictest asepsis must be observed. If suppuration occurs the usual surgical treatment of abscess must be carried out.

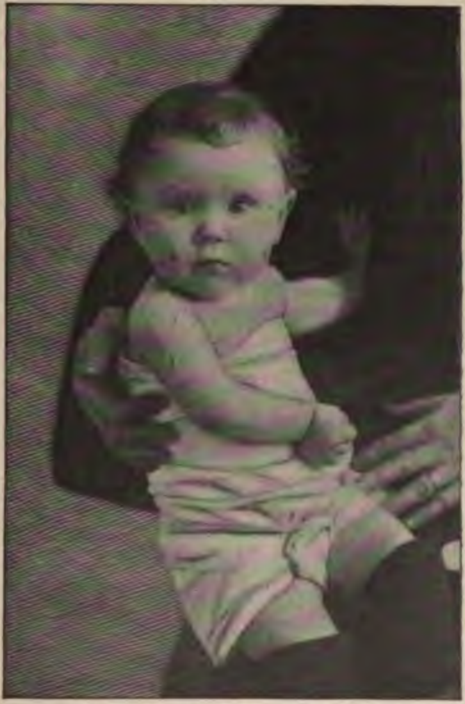
Injuries to Bone and Muscles. The soft and partially developed condition of infantile bone renders it liable to injury if subjected to much mechanical violence during delivery. The cranial bones are especially liable to indentation and fracture when the forceps is employed, yet such accidents may occur in spontaneous labor. Fracture of the cranial bones is most frequently in the parietals. When the brain is not injured the fracture is not apt to result seriously. Rupture of intracranial blood-vessels may lead to fatal hemorrhage. Simple indentations apparently cause little if any damage to the brain structures. Gentle efforts at reduction may be attempted, and thus the normal shape be restored. Fracture of the inferior maxillary bone may result from traction with the fingers in unskilful delivery of the after-coming head in breech presentations. Injuries may be inflicted upon the vertebræ or the spinal cord, with resulting paraplegia, and they are almost invariably fatal. Fracture of the humerus not uncommonly occurs in forcible delivery of the arm in breech births, or separation of the epiphysis from the shaft of the bone may take place. Fracture of the clavicle usually results from violent use of the fingers in extracting the after-coming head. The femur may be fractured from misdirected traction with fingers or fillet in breech delivery. Hæmatoma of the sterno-cleido-mastoid muscle may result from artificial interference in breech extractions. A hard tumor about the size of a pigeon's egg may be seen developing in this muscle, usually on its anterior border. It is noticed between the ages of one and six weeks, and usually disappears by absorption in a month or so. The muscle fibres are sometimes torn. Hæmatoma of the sterno-cleido-mastoid may lead to contracture of the injured muscle and torticollis.

Birth Palsies—Facial Paralysis. Injuries to the nerves during birth may be central or peripheral. The former injuries are, fortunately, the less frequent.

Pressure upon the seventh or facial nerve at the stylo-mastoid foramen by the blades of the forceps is usually responsible for facial paralysis. The affection is, in most cases, unilateral, and will not be noticed when the infant is at rest. When nursing or crying the palsy of the affected side is apparent. Recovery usually takes place spontaneously in a few weeks. If the paralysis does not disappear promptly, faradism may be employed. In rare cases the palsy is permanent.

Duchenne's Paralysis. The next most frequent peripheral palsy is seen in the arm. Various conditions during birth may produce compression and injury of the nerves about the shoulder, such as severe pressure of the obstetrician's finger or the blunt hook in the axilla, hæmatoma of the sterno-cleido-mastoid, or fracture of the humerus with displacement of the fragments. The greatest number of upper-arm paralyses, generally known as Erb's or Duchenne's paralysis, occur after breech deliveries. The injury usually results from traction made upon the shoulder in the delivery of the head, or in bringing down the arm when it is found above the head, or upon the head in vertex deliveries, and is due, as a rule, to stretching of the fifth, sixth, and seventh cervical nerves. Dragging the head or the trunk strongly to one side is usually responsible for the excessive traction upon the nerve trunks of the injured side. The deltoid,

FIG. 362.



Duchenne's paralysis. (JEWETT.)[1]

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[1] By courtesy of Dr. Wm. H. Haynes.

biceps, brachialis anticus, and supinator longus are the muscles oftenest affected. In mild cases the paralysis may not be noticed for some weeks, while in severe ones it will usually be apparent at once.

Diagnosis. The position of the arm is characteristic. It hangs helpless at the side and is rotated inward (Fig. 362). As the triceps is not affected, the child can extend the forearm, but cannot flex it. After a few weeks the affected muscles show more or less atrophy, but the child will generally begin to use the forearm. The diagnosis of Erb's paralysis is not, as a rule, difficult when seen during the first year. The peculiar position of the arm and the group of muscles involved are rarely met with in any other affection at this early age.

Prognosis. The prognosis will depend upon the severity of the symptoms and the time when the treatment is begun. Spontaneous recovery takes place in some cases within two or three months. If there is but little improvement after this length of time, spontaneous recovery is not to be expected, and the case demands active treatment. In some cases partial paralysis may remain for several years or be permanent.

Treatment should be begun as early as the third month, and should consist in frictions or massage and the persistent use of electricity. If the muscles react to the faradic current it may be used; but if not, the galvanic current must be employed. The treatment must be continued for several months, or until recovery is nearly complete. The foregoing treatment applies also in facial paralysis.

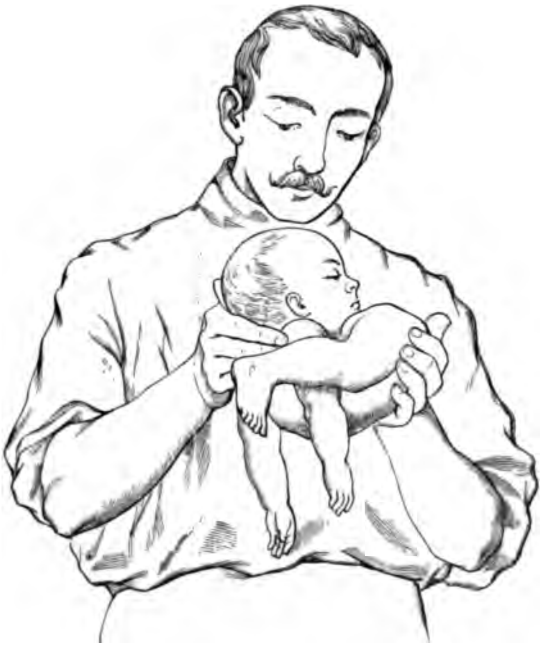
Central Paralysis. A form of meningeal apoplexy, followed by hemiplegia, is one of the results of prolonged and difficult labor. It has been supposed that the use of forceps is largely responsible for this accident, and the rough and careless use of instruments is doubtless a competent cause. The writer believes, however, that too long delay in the application of the forceps when the head is being subjected to prolonged pressure is oftener responsible for this unfortunate accident. The careless use of ergot before delivery, by inducing a tetanic contraction of the uterus, also favors congestion of the fœtal brain.

Symptoms and Prognosis. The symptoms induced by meningeal extravasation depend, of course, upon the seat and extent of the effusion. The extravasation is frequently located over the motor convolutions, and if not extensive the hemiplegia may disappear with the absorption of the blood. If more extensive, however, the infant may be stillborn, or, if living, it may soon die from asphyxia or in a comatose condition. Convulsions may occur shortly after birth, followed by coma. If death does not ensue the prognosis for the extremities affected is good, as the paralysis gradually improves, often undergoing complete recovery. The brain, however, may be irreparably injured, as shown by subsequent epilepsy or even by various degrees of idiocy.

Treatment. The treatment must be preventive. This consists in avoiding as much as possible prolonged pressure upon the fœtal head, in a careful use of the forceps, and in seeing that the infant cries immediately after birth, thus being assured that the lungs are inflating. It is of great importance that the transition from the fœtal to the post-natal circulation should at once take place at birth, as otherwise great damage may be done, particularly to the brain; the vessels here are fragile and easily ruptured. If the infant cries the expanding lungs draw off the excess of blood that may do damage elsewhere. The physician should give his first attention to the infant until this happens, as a short period of asphyxia may do incalculable harm. If the lungs do not act, it is well to let the cord bleed to the extent of a few drachms to prevent severe congestion of other vital organs.

Asphyxia. The accidents during labor that induce asphyxia are: Sudden death of the mother, constant pressure upon the umbilical cord, severe compression of any part of the fœtal body, especially the head, as noted above, and more or less complete detachment of the placenta. In consequence of the air-hunger induced by these conditions, a vigorous infant may by inspiratory suction take in secretions of the birth-canal, which may cause suffocation after birth or induce pneumonia later. Very feeble infants may fail to establish respiratory movements after birth, owing to weak or defective muscles and nerves. In partial asphyxia there is congestion and suffusion of the skin, with blueness of the mucous membranes, full pulse, and moderate action of the reflexes. As the symptoms of carbon-dioxide poisoning become more marked, the pulse grows feebler, the skin paler, and the mucous membranes assume a grayish-blue color. The reflexes are likewise lost. The prognosis in the latter condition is exceedingly bad. In the milder degrees of birth-asphyxia recovery usually ensues.

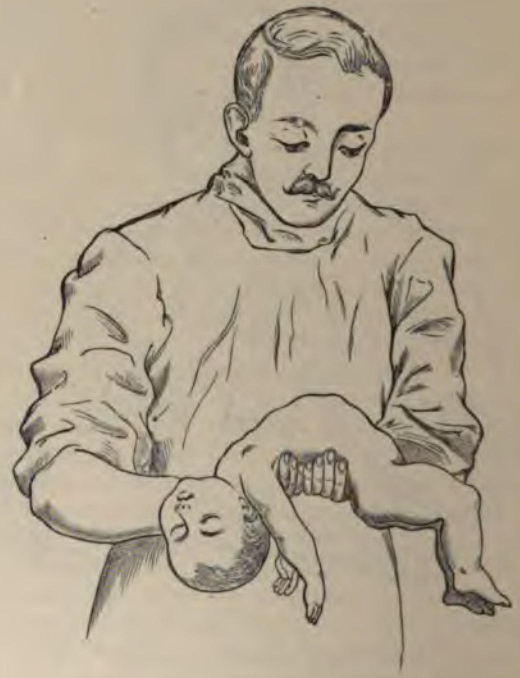
FIG. 363.



Byrd's method—expiration. (JEWETT.)

THE PREVENTIVE TREATMENT consists in measures addressed to the acceleration of tedious labors and the prevention of prolonged pressure upon the fœtal parts, especially the head. During descent of the head malpositions of the cord, especially prolapse, or winding tightly around the neck, must be looked for, and, if possible, corrected. One of the possible causes of asphyxia will be removed if as soon as the head is born it is so turned that the face shall not lie in a pool of blood and liquor amnii. At the same time the mouth and fauces can hastily be cleaned of mucus with a moist rag drawn over the finger, or by means of a soft rubber tube with a rubber bulb attached. In moderate degrees of asphyxia the stimulus of the cool external air, and allowing a drachm or two of blood to escape by the cord, will be sufficient. Should this not suffice the chest may be sprinkled with cold water to stimulate the reflexes, while the infant is held suspended by the feet for the purpose of allowing mucus to gravitate from the air-passages. The child may be plunged alternately into hot and cold water. The hot water should have a temperature not exceeding 105° F. When these external stimuli fail to excite respiratory movements, resort must be had to artificial respiration.

FIG. 364.



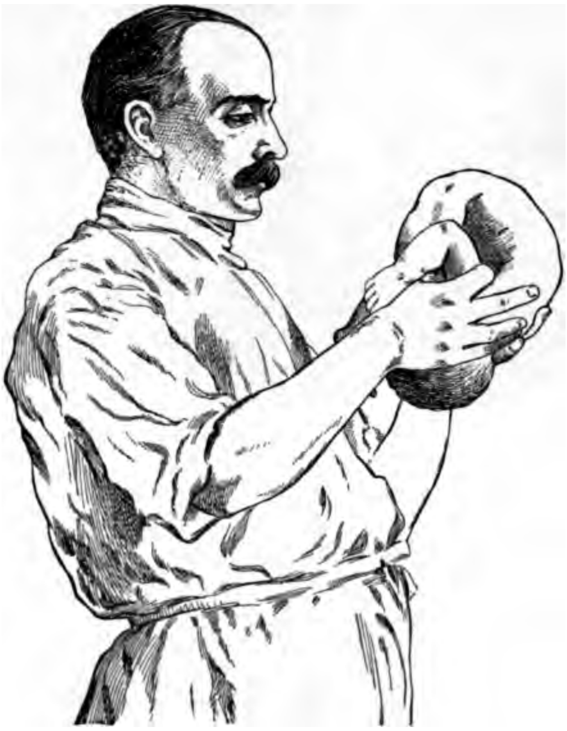
Byrd's method—inspiration. (JEWETT.)

The child's pharynx should first be cleared of mucus and other liquid material that may have been drawn into it by premature efforts at respiration. The simplest and most effectual method of inflating the lungs is by direct insufflation—the mouth-to-mouth method.

DIRECT INSUFFLATION. The child is placed upon its back with the head extended by means of a small pillow or roll of clothing placed under its neck; the mouth is well cleansed and a towel or handkerchief is spread over the face. With one hand closing the nose, and with the other making pressure upon the epigastrium, to prevent the inflation of the stomach, the physician forces air from his own gently into the child's mouth and inflates the lungs. The air is expelled by gentle pressure upon its chest, and the process then repeated. When properly performed, this method is safer than passing a catheter or other instrument into the trachea, as is sometimes practised. Care should be taken lest injury be done to the air-cells by too forcible expansion.

BYRD'S METHOD is simple and efficient, and can be conducted without rough handling, a matter of no little importance. The child lies upon its back on the palmar surfaces of the operator's outstretched hands.

FIG. 365.

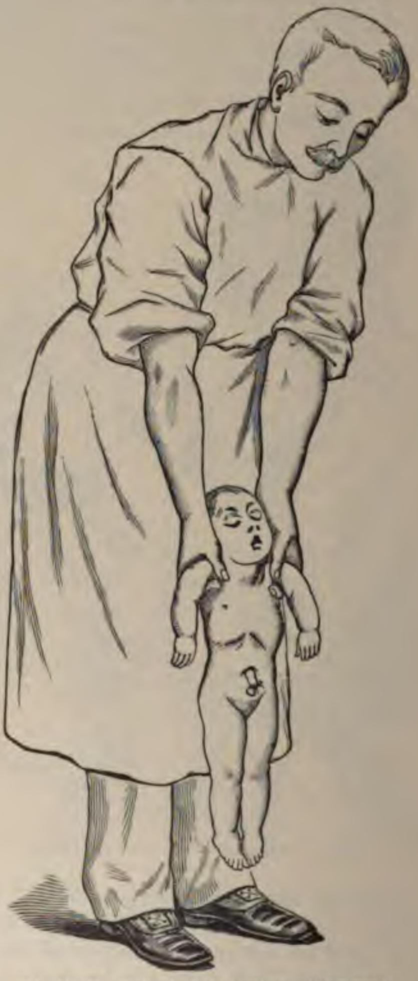


Schultze's method of artificial respiration—expiration. (JEWETT.)

The operator by elevating the radial edges of his hands doubles the child's trunk upon itself—*expiration* (Fig. 363). Then by lowering the radial well below the level of the ulnar borders of the hands the child's trunk is thrown into a position of extreme extension—*inspiration* (Fig. 364).

THE METHOD OF SCHULTZE is as follows: The operator holds the infant suspended, face to the front, his index-fingers being hooked in the axillæ, the thumbs resting on the front of the chest and the fingers upon the infant's back. The lower portion of the child's body is now swung outward, upward, and finally toward the operator's face, inverting the position. Care should be taken that the trunk is most strongly flexed in the lumbar region. In this position the thorax is compressed—*expiration* (Fig. 365). The child's lower extremities are now swung outward away from the operator's body and downward till the child hangs suspended by its axillæ in the position first described. In this position of the child, hanging by its upper extremities, the abdominal contents fall and the diaphragm sinks—*inspiration* (Fig. 366). To assist the respiratory movements the pressure of the operator's thumb is relaxed during inspiration and increased during expiration. This method is not to be recommended in feeble children.

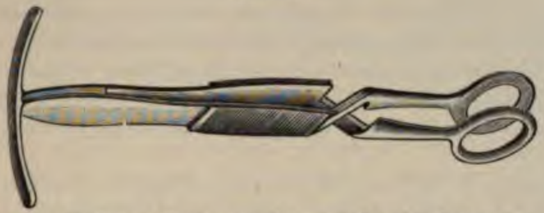
FIG. 366.



Schultze's method—inspiration. (JEWETT.)

LABORDE'S METHOD. Laborde recommends rhythmical traction upon the tongue eight or ten times a minute as an effective method of establishing respiratory movements. It has the advantage that it can be carried on while the child is kept in the warm bath, and it does not involve rough usage.

FIG. 367.



Laborde's forceps for traction on the tongue of the new-born in the treatment of asphyxia. (After RIBEMONT-DESSAIGNES and LEPAGE.)

OTHER MEASURES. It must be borne in mind that it is not enough that the child begins to breathe: it must be watched for some time to see that the respirations continue. It may be advisable in some cases to administer hypodermically ten to twenty drops of whiskey combined with 1 minim of tincture of belladonna or $\frac{1}{100}$ grain of strychnine. In most cases it will be necessary after resuscitation to apply dry heat by a hot-water bag or other means. In asphyxia pallida a rectal injection of water at a temperature of 110° F. is of marked service.

Atelectasis. Closely allied to asphyxia, and often associated with it, is a persistence of the fœtal condition of the lungs, either of one or both in whole or in part. It is due to failure of the infant to completely inflate the lungs, and may persist for a considerable time. Sometimes it results in death, even after respiration had apparently been fully established.

This is more apt to involve the lower lobes than the upper ones. It is frequently seen in premature infants with feeble respiration. The cause may also be injury to the brain from pressure. The symptoms are those of deficient respiratory action, such as pallor, feeble cry, and poor circulation, with very little expansion of the chest-walls over the affected area. Deep inspiration may be encouraged by artificial respiration, and the vitality conserved by the external application of heat and the judicious administration of nourishment and stimulants.

Fœtal Death must be distinguished from asphyxia. In the former the heart pulsations cannot be felt, and respirations and reflexes are absent. In the latter the heart is pulsating, reflexes are present, and there may be feeble attempts at respiration. We should not refrain from efforts at resuscitation because the heart-sounds are absent or no pulsations can be felt in the præcordial region. The distinction between a deadborn and a stillborn infant can usually be made by the rapid fall of rectal temperature in the former to ten or fifteen degrees below normal and by the widely dilated condition of the pupils in the deadborn. One or two forcible inflations of the lungs by the mouth-to-mouth method will usually cause the heart to pulsate in the stillborn, while it will have no effect on the deadborn. If the heart pulsates after this trial, a hypodermic injection of whiskey, ℳv–x, and strychnine, gr. $\frac{1}{100}$, may be given and artificial respiration continued.

Diseases of the New-born.

Mastitis. The mammary glands of the new-born infant often secrete a milk-like substance, which appears between the fourth and tenth days after birth. During this time there may be swelling of the glands, which gradually abates with the subsidence of the secretion until, usually by the twentieth day at the latest, both secretion and swelling have disappeared. In some cases, however, the glands may remain engorged and tender, and suppuration ensue. This implies infection, and is exceedingly rare when proper antiseptic precautions have been observed during and after labor.

TREATMENT. When there is simple swelling the parts may be cleansed with soap and water and bathed with a weak antiseptic solution, either of carbolic acid or bichloride of mercury. Gentle support with absorbent cotton and a bandage will also be indicated. If, in spite of this, suppuration occurs, there will be rise of temperature and the local signs of abscess. Then early incision, under proper antiseptic precautions, constitutes the treatment.

Umbilical Hemorrhage. Hemorrhage may take place from the stump of the cord shortly after birth, from insecure ligation, from shrinkage of the funis, or from slipping of the ligature. Laceration of the cord between the abdomen and the ligature may also be responsible for hemorrhage. Secondary hemorrhage, usually between the fifth and fifteenth days, may occur, even though the cord has been securely ligated and properly watched. The trouble may be due to changes in the walls of the minute bloodvessels, allowing transudation, or to imperfect coagulability of the blood. In the latter case the hypogastric artery and the umbilical artery and vein have not been tightly occluded by the usual fibrinous plug. The hemorrhage is accounted for by syphilis, jaundice, hæmophilia, or by depraved health on the part of the parents.

TREATMENT. The great majority of cases are fatal from the impossibility of controlling the hemorrhage. In the milder ones a compress of lint tightly applied with adhesive strips may be sufficient. In more obstinate cases the lint may be saturated with a styptic, such as Monsel's solution. Dr. J. L. Smith recommends filling the umbilicus with a thick layer of plaster-of-Paris that is supported by the hand until it hardens, and then secured by a bandage. In the most obstinate bleeding the umbilicus may be transfixed with two needles placed at right angles, and a figure-of-eight ligature be placed tightly around them.

Umbilical Vegetations. Fungous granulations at times appear, arising from the floor of the umbilical fossa, shortly after the falling of the cord. They may attain the size of a pea, and they usually exude a bloody serum, which may induce excoriations in the surrounding skin. The granulations may gradually atrophy after weeks or months of sluggish existence. The constant moisture and discharge is, however, a source of irritation, and it is best to destroy the growths. This can be accomplished by repeated cauterization with the solid stick of nitrate of silver, or, better still, by passing a ligature around the base of the mass and amputating the exuberant granulations with scissors. A dry dressing of boric acid, subnitrate of bismuth, or iodoform may then be applied.

Umbilical Hernia. There may be an incomplete closure of the umbilical ring from defective development of the abdominal wall, with resulting protrusion of abdominal viscera at this point. Tendency to protrusion must be corrected at once by the constant application of a pad or truss. If this is not sufficient, or if the rupture increases rapidly in size, immediate operative interference is demanded.

Icterus Neonatorum. Icterus is a common affection of the new-born. Two distinct varieties are recognized, differing widely as regards causation and prognosis, and known as the mild and the grave forms.

MILD FORM. Two divergent theories have been advanced to account for this form. The first considers the jaundice to be purely hæmatic; the second theory regards it as hepatic in origin. Bile is first formed in the liver, and then carried into the circulation, the resorption being due either to congestion or to œdema of the hepatic tissue. It seems highly probable that both these theories may apply in different instances, and doubtless many cases of icterus neonatorum are to be satisfactorily explained only by taking into consideration a morbid condition of both the blood and the liver, thus combining the hæmatic and hepatic theories.

The intense congestion of the skin observed during the first few hours of life often produces a yellowish coloration that cannot be considered jaundice. It is of the same nature as the discoloration of the skin following an ordinary cutaneous bruise. The yellow tint is at first seen only on deep pressure, but as the erythema fades the yellowness increases. The conjunctivæ are not colored, and the urine appears normal. This yellowness is usually first noticed on the second day, and may continue a few days or a week.

The term "true icterus" can be applied only to those cases in which the yellow discoloration of the skin is caused by a staining by the bile pigments. This more often occurs in cases of prolonged or difficult labor, in children born asphyxiated or before term, and in generally feeble infants. It is very frequently seen in foundling asylums. It may appear as early as a few hours after birth, but usually is not marked until the second or third day. In very mild cases the yellow color may appear only on the face, chest, and back, the conjunctivæ being but faintly tinted and the urine and feces normal in appearance. In severer forms the urine may be high-colored enough to stain the linen, and the jaundiced hue may extend to the arms and abdomen. Some infants present a yellowish discoloration of the whole body, with typical clay-colored stools. In most cases the jaundice has disappeared by the eighth or tenth day. It may, however, persist for several weeks. In rare cases, after having much diminished, it reappears with renewed intensity. No matter how extensive this form of jaundice may be, it causes very little constitutional disturbance. The liver may be slightly enlarged, and occasionally there are symptoms of intestinal catarrh. A few small doses of calomel or mercury with chalk will be all the medication required.

GRAVE FORM. This form is, fortunately, rare, and may be produced by several different conditions. Defects in the bile-ducts will first be mentioned as among the commonest causes. In some cases all the large bile-ducts have been absent; in others the ductus communis choledochus has been narrowed, obliterated, or entirely absent. Sometimes a fibrous cord has been found in place of the gall-duct. The cystic duct has been absent and the gall-bladder in a rudimentary condition. Accompanying an obliteration of the gall-ducts cirrhosis is usually found in the liver, which will be more or less marked, according to the length of time the infant survives. The liver is generally enlarged. Jaundice that is due to obstruction or obliteration of the biliary passages may appear a few hours after birth, and soon acquire a marked intensity. It often, however, does not appear for one or two weeks after birth. The yellowish discoloration of the skin may vary from day to day, at times being much more intense than others. The conjunctivæ are yellow. The fecal discharges lose color and have an offensive odor, while the urine stains the napkin a yellow or greenish-brown. The spleen, as well as the liver, is usually enlarged, which partially accounts for the increase in size of the abdomen. Umbilical hemorrhage is a grave and not infrequent symptom in this form of jaundice. The bleeding is not sudden and profuse, but begins as an oozing shortly after the separation of the navel string. It is apt to commence at night. Death is always hastened by this accident, and exhaustion from loss of blood is added to that induced by indigestion and malassimilation. There may also be a species of general purpura, bleeding taking place from the nose, mouth, or stomach. Infants may live for several months with impervious or defective bile-ducts, though death usually takes place earlier, from failure of nutrition.

Another form of grave icterus neonatorum is observed in connection with certain inflammatory changes in the liver, usually taking the form of an interstitial hepatitis, with which may be conjoined inflammation of the biliary canals. This lesion is apt to be one of the results of congenital syphilis, as is likewise perihepatitis, which may cause a complete obliteration of the biliary passages. The latter form of inflammation often involves the connective tissue surrounding the common duct, the portal vein, and the hepatic artery on the under surface of the liver. These cases, however, may not always be of syphilitic origin. Perhaps the commonest manifestation of the grave form of icterus in the newly born is seen in connection with septic poisoning—that is, generally accompanied with phlebitis. This will be considered under the head of sepsis.

Umbilical Infection. The umbilicus is the most vulnerable spot for the entrance of septic poisons during or shortly after birth. Upon ligation of the cord the blood that remains in the umbilical veins forms small thrombi that should gradually harden, and in time become calcified, forming a fibrous cord in the same manner as in the ductus arteriosus and ductus venosus. In these latter structures the formation of thrombi is never accompanied with grave consequences, since their internal situation prevents the access of infectious agents. Pyogenic organisms, however, can readily gain access to the umbilical vein, and give rise to umbilical phlebitis and septicæmia.

There is a constant alteration after birth in the blood-pressure in the umbilical vein, due to the action of the heart and lungs, by which a sort of flux and reflux is produced. This favors infection of the system when the contents of this vein become septic.

This grave accident is liable to occur when the mother is in a septic condition. The poison may be produced by the same agents that have caused the puerperal fever. In these cases of sepsis there is a puriform or yellow softening of the thrombi that fill the umbilical vein.

The softened matter consists of pus-corpuscles and finely granular matter containing micrococci. This sets up an inflammation not only in the vessel itself, but also in the surrounding tissues. Infective emboli may be carried to various parts of the body. As the micrococci enter the umbilical vein from the umbilical fossa, owing to the perviousness of this vessel, the structures near at hand, especially the liver, bear the first brunt of the septic inflammation. The latter organ is usually found much diseased or degenerated. There is severe jaundice, with constant elevation of temperature and other symptoms of general septic infection. If the infant lives long enough peritonitis will probably develop, and sometimes empyema or even meningitis. In all cases evidence of severe illness and prostration are present. Cutaneous, mucous, or visceral hemorrhages may supervene at any time. The abdomen is generally swollen and tender, and dirty-looking pus may be seen oozing from the navel; slight pressure about the umbilicus will often cause pus to exude if it is not otherwise apparent. The fecal discharges may be of natural appearance, but the urine is usually highly colored. The infant refuses nourishment, and there may be vomiting of greenish matter. Severe nervous symptoms, such as convulsions or coma, supervene before death. While the umbilicus is the most common seat of septic infection, any sore or abrasion elsewhere may afford entrance to germs. Erysipelatous eruptions on the abdomen, chest, or other parts, are the most frequent manifestations of such infection.

TREATMENT. The prophylactic treatment of sepsis consists in the careful antiseptic management of labor and proper attention and cleanliness in reference to the navel. Localized sepsis may be combated by the topical use of peroxide of hydrogen, bichloride of mercury solution, or other strong antiseptic agents.

The remedial treatment of systemic infection consists in full stimulation and general support and the judicious use of external refrigerant measures. In the latter condition, however, treatment is generally futile.

Conjunctivitis. The conjunctival membrane in the newly born is very sensitive, and frequently the seat of inflammation. A mild catarrhal inflammation is often seen, unattended by swelling of the lids, the inner surface being reddened and covered with a slight viscous secretion. The eyes must be kept cleansed by frequent bathing or irrigation with a saturated solution of boric acid. A little vaseline may be applied to the lids to prevent retention of the secretion by adhesion of their edges.

Ophthalmia Neonatorum. This form of purulent conjunctivitis may be due to infection by the gonococcus or by various pyogenic cocci. The former is the infecting agent in about 36 per cent. of cases. If the disease manifests itself by the second or third day, the infection probably took place during birth. When there is a delay of a week or more, however, the virus has probably been conveyed by careless attendants, by soiled fingers or other infected objects. The inflammation is of an intensely virulent type, involving both the ocular and palpebral conjunctivæ. The sac is filled with a grayish muco-purulent secretion, and there is intense chemosis. The subconjunctival connective tissue and skin are much swollen, so that the eye can only with difficulty be opened. There are photophobia, pain in the eye, and rise of temperature. Unless the symptoms quickly subside, the eye is irreparably damaged by ulceration and partial destruction of the cornea. The inflammation begins in one eye, but soon attacks the other unless it is effectively protected.

THE PROPHYLACTIC TREATMENT consists in employing antiseptic vaginal douches in the parturient woman when there is any mucopurulent discharge, and dropping two or three drops of a 2 per cent. solution of silver nitrate into each eye immediately after birth, after the method proposed by Credé.

CURATIVE TREATMENT. When the inflammation has actually begun the eye must be kept as free of pus as possible by constant washings with a saturated solution of boric acid. The swelled and puffy lids should have applied to them every few minutes pledgets of sheet lint that have been kept upon a cake of ice, and the pus must be removed every hour or two. Constant cleansing and cooling of the surface will require the services of a careful nurse night and day. A 2 per cent. solution of nitrate of silver, or of bichloride of mercury one or two grains to the pint, may be instilled between the lids every two or three hours, according to the severity of the case. As this affection so frequently results in blindness, it is well, if possible, to have the advice of an oculist. Protargol in 10 per cent. solution has been recently recommended as a substitute for nitrate of silver. It has the advantage of being less painful, and is said to be equally efficient.

Tetanus Neonatorum. Although this disease is distributed through a wide geographical area, it is most apt to be found in filthy surroundings. Something beside filth, however, is necessary; there must be a specific cause. This consists in the tetanus bacillus, of the pin-head and bristle-shaped form. It may exist in straw or dust from hay, which explains the fact that horses are subject to tetanus, and that traumatic tetanus is often seen among laborers who are employed about farms and stables.

The disease usually begins during the first ten days of life, and the onset is apt to be preceded by great fretfulness. Disinclination to nurse is soon followed by rigidity of the voluntary muscles, usually starting in the masseters. The rigidity increases, reaching its maximum in from twelve to twenty-four hours. The head is thrown back, and there is a general flexion of the extremities. One peculiarity of the disease is that while the toes are flexed the great toes are adducted. There may be some relaxation at times, especially during sleep, but there are constant exacerbations, provoked by any peripheral irritation. Respiration and circulation may be extremely embarrassed, and opisthotonus may be present during these exacerbations.

TREATMENT. While the specific cause of the disease may gain entrance at any point of the body when the necessary lesion exists, the umbilical wound is undoubtedly the seat of infection in the great majority of cases of tetanus neonatorum; hence the utmost cleanliness must be observed in cutting the cord and in dressing it. The scissors, the ligature, and the entire management of the navel, cord, stump, and the umbilical wound must be rigidly aseptic. The excess of the gelatinous matter should be stripped from the cord, and a dry, antiseptic dressing applied. Speedy mummification of the stump is the best safeguard against infection. Special care must be exercised in the umbilical dressings where the dwelling is easy of access to stable-yards containing horse-manure or loose earth.

When the disease is once established it is almost invariably fatal. In cases of suppuration at the umbilicus, frequent cleansing with a solution of mercuric bichloride of suitable strength should be employed. With reference to drugs, the two most valuable are potassium bromide, gr. iv every two to four hours, and chloral hydrate, gr. j every hour. Sulphonal, gr. iij every two hours, by the rectum, has been recommended. While these are administered the infant must be given nourishment frequently, and stimulants should be freely employed. The difficulty of swallowing, however, is a source of embarrassment in satisfactorily carrying out these measures. A tetanus antitoxin is now produced by several manufacturing chemists, but so far little experience has been reported in the serum treatment of tetanus neonatorum.

Tubercular Infection. Tuberculosis is very rare in the newly born, and is not common in the first year. It has been disputed that the fœtus can be infected by tubercle bacilli in the uterus, but the evidence seems to show that such infection may occasionally, though rarely, take place. Acute miliary tuberculosis, however, may develop within the first few days of life. In very early life the lymph tracts and bones are especially liable to tubercular infection. The prominent symptoms are irregular fever, rapid wasting, and prostration. Increased frequency of respiration and bronchial râles are present, but the infants usually die from a general infiltration of all the organs with fine, miliary tubercles before they have time to localize sufficiently in any one organ to be detected by physical signs.

Syphilis. This disease may be acquired from the father or mother, or from both parents, the poison being conveyed by the spermatozoa of the male or the ovum of the female. While it has been denied by some observers that the father alone can transmit syphilis, the consensus of opinion is in favor of the possibility of such transmission. Without antisyphilitic treatment the spermatozoa can usually convey the syphilitic poison during the first year after primary infection, and there is great danger to the fœtus from syphilitic contagion up to the fourth year. The influence of the mother upon the growth and development of the fœtus contained within her uterus is obviously very great, and when she is suffering from constitutional syphilis the disease is transmitted in an active stage to her child. The degree of such transmission depends, as noted above in the case of the father, upon the stage and severity of the disease and the nature of the treatment employed. During periods of latency the mother may bear healthy children, followed by abortions or syphilitic infants caused by renewed manifestations of the disease. It has been considered that the power of transmission is practically lost at the end of six years.

Colles' Law. In 1837 Colles wrote that "A new-born child affected with inherited syphilis, even though it may have the specific lesions in the mouth, never causes infection of the breast which it sucks if it be the mother who nurses it, although continuing capable of infecting a strange nurse." The substantial truth of this dictum has not been seriously questioned, though various explanations have been offered.

When the virus of the disease is concentrated, as in cases where both parents are syphilitic, the fœtus will be attacked by the disease in the uterus, and, as a result, abortion will occur more or less early in the pregnancy. As the disease abates in one or both parents the pregnancies will be longer in duration, until, at last, apparently healthy infants may be born. In some cases the infant will present marked evidences of syphilis at birth; often, however, the onset is delayed until later, and at birth there may be absolutely no manifestation of the disease. The earlier the disease shows itself after birth the graver will be the nature of the attack.

Very early syphilis is usually accompanied by emaciation, eruptions of bullæ, particularly upon the palms of the hands and soles of the feet, and an extreme degree of coryza, cracked and ulcerated lips, and evidences of visceral and bone disease. In the older cases there may be no interference with nutrition, and possibly one or two mucous patches may be the only active evidence of the infection.

TREATMENT. The treatment may be local or internal. Daily inunctions of mercurial ointment mixed with from four to eight times its quantity of vaseline or rose ointment are efficacious. It may be rubbed on the inside of the thighs or in the axillæ, using a portion about the size of a hickory-nut. A more cleanly method of local medication consists in applying five drops of a 10 per cent. solution of oleate of mercury three times daily. Mercury with chalk may be internally administered, in doses of $\frac{1}{4}$ grain to 1 or 2 grains twice daily. Calomel has a more rapid action in doses of from $\frac{1}{20}$ to $\frac{1}{6}$ grain three times a day. Parents who exhibit evidence of syphilis or who have had syphilitic children should be subjected to full specific treatment.

Thrush, or Sprue. This is a disease liable to make its appearance during the first or second week after the birth of an infant, especially when cleanliness of the mouth, bottle, or nipples is neglected. It is a parasitic disease, characterized by the appearance of small white patches or flakes on the tongue, inside the cheeks, or on the palate. The parasite which produces sprue is a fungus consisting of a mycelium network resembling the moulds and spores. These spores are to be found in the air at all times, and they grow in the mouth only in a pathological condition of the epithelium, such as catarrhal inflammation or uncleanliness. The fungus belongs to the saccharomycetes, or sugar-fermenting organisms. It has received the name of *saccharomyces albicans,* and was formerly known as the *oidium albicans.* When examined with a low-power microscope, the white patches are found to consist of small threads and small oval spores. With a higher power the threads are shown to be made up of small rod-like segments connected together at the ends. From these shorter rods the spores are developed. These spores when placed in suitable conditions germinate and produce the thread or mycelium. They exist in the atmosphere, and when they are deposited upon a mucous membrane previously irritated or the subject of catarrh, they grow, producing the patches above described. The growth usually begins at many isolated points in the mouth and spreads out into larger patches, which often coalesce, forming a more or less continuous membrane. Almost the whole of the tongue, cheeks, and hard palate may become covered with this membrane. It may even extend to the soft palate and pharynx, but rarely into the stomach or intestines.

SYMPTOMS AND DIAGNOSIS. The appearance of the white patches in the mouth of the infant, firmly adhering to the membrane, is sufficiently characteristic to make the diagnosis easy and certain. The mucous membrane of the mouth is usually dry. If the patches be forcibly removed, the mucous membrane beneath appears red, and will frequently bleed. When these deposits appear upon the tonsils or soft palate they may be mistaken for diphtheritic exudate, a mistake which is hardly possible if all the symptoms are taken into consideration. The disease is not in itself a dangerous one, and in many cases it should be regarded only as a symptom of debility or inanition.

TREATMENT. Most important is prophylaxis. Careful attention to cleanliness of the mouth, nipples, bottles, clothes, etc., will usually prevent the occurrence of sprue. The infant's mouth should be carefully cleansed several times a day with some mild antiseptic solution, as boric acid or sodium salicylate slightly sweetened with glycerin.

On the first appearance of the white specks or patches in the mouth of an infant, it should be washed after each nursing with a 3 per cent. solution of hydrogen dioxide, sweetened with glycerin, or a solution of sodium benzoate or sodium salicylate, ten grains to the ounce. The popular solution of borax and honey is objectionable, since the honey feeds the ferment and causes it to grow more rapidly, while the borax is not a sufficiently active antiseptic to prevent it.

The nurse should be cautioned against using harshness in washing the mouth, lest she make it sore. No attempt must be made forcibly to detach the membrane. If the child is nursed at the breast, the nipples should be washed with one of the above antiseptic solutions after each nursing; if artificially fed, the rubber nipples must be thoroughly disinfected after using.

Indigestion and colic are frequent complications of sprue. The passages become green and slimy and contain undigested curds and fats. It is quite probable that the swallowed ferment leads to acid fermentation in the stomach or intestines, with the production of excessive acidity of the stools, and frequently the appearance of troublesome erythema of the nates. The gastro-intestinal disorder, as well as the primary affection, will need careful attention. With proper treatment the disease is easily managed.

Colic. This is a common affection of the new-born infant. The pain is usually the result either of flatulence or excessive acidity, due to indigestion and acid fermentation. Usually the paroxysms come on at certain hours of the day, with intervals of complete or partial freedom from pain. It is more prevalent in artificially fed infants than in those nursed at the breast. Once established in early infancy it usually continues with more or less severity for two or three months. The importance, therefore, of careful attention to the food and the feeding of infants during their first week becomes self-evident.

Intestinal fermentation, or decomposition of the food or of the intestinal mucus, with the production of gas and distention of the bowels, is almost uniformly present. This distention and the irritation of the mucous membrane by the products of the fermentation induce spasm of the muscular fibres of the intestinal walls, which is the immediate cause of the pain.

The most frequent cause of infantile colic is overfeeding during the first two or three days after birth, or feeding with improper foods.

When the infant is to be nursed by its mother, no other food should be given, unless the mother's milk is manifestly delayed or abnormally deficient. If the child is to be artificially fed, no other food should be allowed than that prescribed by the attending physician. Milk sugar, however, dissolved in water, may be given without harm. In most cases the bottle-fed infant is nursed upon the breast for the first week, unless deformed or sore nipples prevent. In beginning the artificial feeding of infants, nature's method should be followed as nearly as possible. During the first three days small quantities only should be given. The table on page 287 will serve as a guide to the quantity and frequency of meals.

The cause is occasionally to be found in some abnormality in the quality of the mother's milk, the most frequent, during the first and second weeks of lactation, being the persistence of a high percentage of proteids, which we have seen to be characteristic of colostrum. In such cases the infant's stools are usually copious, frequent, and thin in consistency, and may or may not contain undigested masses of curd. A microscopic examination of the milk will reveal the peculiar corpuscles of colostrum. When the fat is excessive, the child will usually vomit after nursing, and the stools will contain excess of fat.

DIAGNOSIS. It must be remembered that crying is not necessarily due to colic. Often the cause is need of food. The cry of hunger is usually more constant than that of colic, which is intermittent and paroxysmal. It is not so violent, the child rather fretting than crying, and is quieted by feeding, while the cry of colic is usually rather aggravated than relieved by feeding. The pain may be due to other causes than colic. There is usually, however, little difficulty in distinguishing between colic and other forms of pain. The cry of colic is usually intermittent and violent, the child drawing up its knees during the paroxysms, the abdominal muscles being at the same time tense, and the abdomen usually full and tympanitic. Infants who suffer with colic usually appear to be hungry most of the time, and, consequently, are often overfed.

TREATMENT. The treatment of colic is both palliative and curative. It is doubtful if much benefit is derived from carminatives, such as anise, fennel, chamomile, gin, etc.

Better results are secured usually by enemata of warm water or by irrigations of the colon, especially when the stools are fetid. A pint of warm water injected high up by means of a double soft rubber canula may be used as an irrigant twice daily with great benefit. An injection of three or four ounces of warm water, with half an ounce of glycerin, rarely fails to excite peristalsis with the expulsion of the gas.

Friction applied to the abdomen, following the course of the colon, is sometimes useful. Heat applied by means of warmed dry flannels wrapped about the body or legs, or by holding the bare feet near a warm stove, is sometimes beneficial.

The most useful of drug measures is one grain of chloral hydrate dissolved in a teaspoonful of anise-water, and given once to three times daily. It checks fermentation and quiets the nervous system without disturbing digestion. Five to ten drops of chloroform-water given every hour or two is often efficient in relieving the pains. Milk of asafœtida, ʒj by the mouth, or ℥j by the rectum, is a valuable remedy.

The curative treatment must be addressed to the digestion. The most common cause of the affection in hand-fed infants is overfeeding. Next to this is feeding improper food. Great care is necessary in adapting the food to the needs and power of digestion of the new-born child. It is well to bear in mind that the most frequent cause of colic, as regards the quality of food, is an excess of sugar or casein. An excessive amount of fat may, though rarely, be the cause of colic. The use of farinaceous foods must be prohibited. If the passages are excessively acid and the nates are erythematous, antifermentatives and antacids are indicated. Calomel in one-twentieth-grain doses, with one grain each of sodium benzoate and chalk, may be given every two hours.

The stools must be carefully examined for excessive acidity, fatty acids, or fat, and for undigested casein, and the food modified to suit the indications here given. White, yellowish-white, or grayish lumps in the stools may consist of fat, fatty acids, or casein. Fat and free fatty acids dissolve in ether, while casein does not.

The following paste has been found useful by the author as an antacid and antifermentative laxative remedy in the treatment of colic attended with constipation:

Olei ricini	℥ss.
Magnesii carbonatis	ʒij.
Sodii benzoatis	ʒss.
Sacchari lactis	ʒij.
Olei anisi	gttv.—M.

Sig. Teaspoonful once or twice a day.

Strict regularity in the quantity and quality of food and frequency of feeding and scrupulous cleanliness must be insisted upon. The temperature of the food is also a matter of importance. If the food be given too hot or too cold, it may cause colic. Digestive or nervous disturbances in the mother, which may cause colic in the nursing infant, must receive attention.

PART VIII.

OBSTETRIC SURGERY.

CHAPTER XXIX.

IMMEDIATE REPAIR OF VAGINAL AND VULVAR LACERATIONS AND OF THE LACERATED CERVIX.

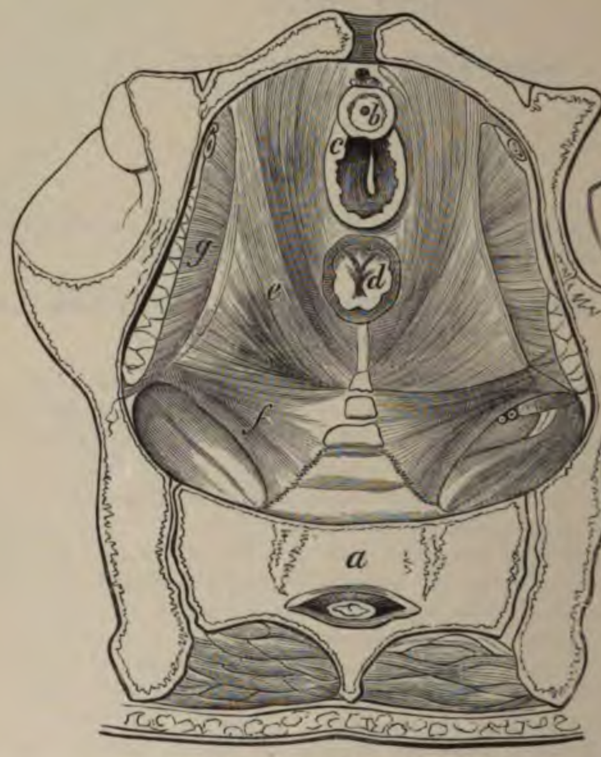
IMMEDIATE REPAIR OF VAGINAL AND VULVAR LACERATIONS.

WITHOUT a thorough knowledge of the anatomy and physiology of the structures concerned, it is impossible to arrive at a scientific method of treating the various injuries to which the vaginal outlet is subjected. It must be remembered that the normal outlet of the vagina is not a gaping orifice, but in the virgin, as she stands erect, appears externally as a mere slit, lying immediately under the vestibule beneath the pelvic arch. In a woman who has born children the outlet may be slightly relaxed without producing any serious consequences, but all marked grades of relaxation must be regarded as pathological. It was formerly thought that the wedge of tissue represented by the perineal body, like the keystone of an arch, formed the main support of the pelvic contents. As a matter of fact, the perineal body in itself has very little to do with keeping the organs in position. Again, it has been recently demonstrated that the levator ani muscle can hardly possess the functions assigned to it in this connection, but that the all-important structures are the fascial sheets of the pelvic floor.

On inspection it will be noticed that both the vaginal outlet and the anus are situated well forward, the former being under the pubic arch. The index finger, when introduced into the vagina, will feel the pubic arch above and to the sides, while as it is passed backward it impinges upon a resilient band of tissue stretching across the floor of the pelvic outlet from one pubic ramus to the other. By making continued firm pressure upon the posterior wall of the vagina a marked relaxation of this band is produced, together with a definite descent of the pelvic floor, which recovers its former position as soon as the pressure is removed.

The recent work of Browning has shown that the levator ani muscle, from its insertion into the perineal body, the external sphincter ani, the postrectal raphe and the coccyx, pulls forward and upward the post-vaginal structures of the pelvic floor. But the same author has shown that in a case examined by him shortly after the expulsion of an eight months' fœtus there was no evidence of stretching of the fibres of this muscle. Again, he argues that it is unphysiologic for a muscle to furnish a continuous support. The recto-vesical fascia lies above the levator ani and sends processes to the bladder, vagina, and rectum. Browning denies that this latter structure is merely a part of the sheath of the muscle, and is of the opinion that, when intact, it is sufficient by itself to afford all the support required to hold up the pelvic contents. The recto-vesical fascia consists of the two layers of the triangular ligament, the superficial fascia and the ischioperineal fascia. Of these, the last named is the most important in supporting the pelvic contents. A perineal tear that permits gaping always involves these sheets. When the ischio-rectal ligament is torn, the pelvic floor sags. But although it is possible that the part played by the levator muscle in supporting the pelvic contents may have heretofore been exaggerated, it is evident that, when it is torn, its restoration as nearly as possible *ad integrum* will always be of the highest importance to the patient, and the condition of this muscle should always be taken into consideration in the treatment of perineal laceration.

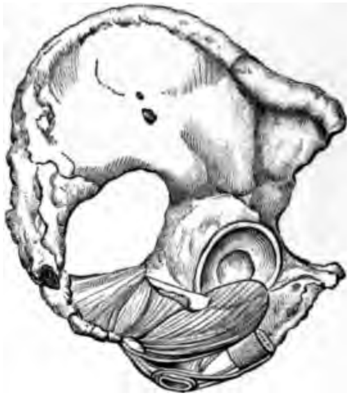
FIG. 368.



Dissection of pelvis, from above. (SAVAGE.)
a. sacrum. *b.* urethra. *c.* vagina. *d.* rectum. *e.* levator ani. *f.* coccygeus. *g.* obturator internus.

Character of the Injury. Injuries to the vaginal outlet occur generally during parturition. Consider for a moment what happens when a moderate-sized child comes into the world. Through an orifice which is normally from 2 to 3 cm., about an inch, in diameter passes a child's head which dilates the outlet until it forms a ring 33 cm., 13 inches, in circumference. It is true that this distention when brought about gradually and equably by repeated advance and recession of the fœtal head may be accomplished without injury, but it not infrequently happens that the delivery is somewhat precipitate, and, instead of gradual stretching, we have rupture of muscular fibres or fascial attachments.

FIG. 369.



Levator ani and coccygeus, seen from without, after removal of part of hip bone and clearing out of ischiorectal fossa. (LUSCHKA.)

a. Fibres of levator ani on vagina. *b.* Anus, with sphincter.

The outlet, when compared with the capacious vaginal cavity within the pelvis, may be likened to the narrow vent of a funnel with a wide mouth. It would seem surprising that so comparatively small a passage is not more frequently injured during the birth of the head and shoulders of a child of ordinary size.

Injuries of the vaginal outlet due to parturition may be divided into three classes:

1. External or superficial tears.
2. Internal or combined external and internal incomplete tears.
3. Complete tears.

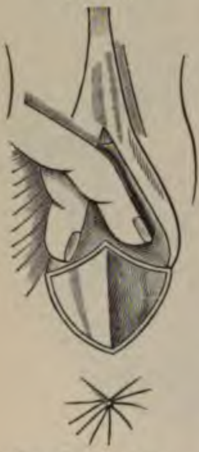
1. **The superficial external tear** begins at the introitus and extends backward, involving the superficial portion of the wedge of lax tissue behind it. The rupture may extend inward beyond the hymen to the side of the posterior vaginal column, which normally lies in close proximity to the vaginal outlet, but which during parturition, when the tissues are put upon the stretch, is found much further back.

So long as a tear does not in any way affect the supporting structures the injury done to the outlet is relatively unimportant. A few superficial stitches are necessary in order that suppuration, granulation, and the formation of sensitive scar-tissue may be avoided. (Fig. 370.) Rupture of the fourchette is the rule, even in normal labors, and need not be repaired; but when the tear has a base of 2–3 cm., $\frac{3}{4}$–$1\frac{1}{2}$ inch, sutures are necessary. The patient should be placed with her body across the bed, the buttocks being made to overhang the side; the legs are flexed upon the thighs, and the thighs in turn upon the abdomen, the position being maintained by assistants or by means of a leg-holder. The labia having been drawn apart, the raw surfaces can be made out as two triangular areas separated at their apices, which are formed by the divided fourchette, and united at a common base.

The instruments required are (1) a needle-holder, (2) a small curved needle, (3) a few silk or catgut sutures 22 cm. (8 inches) in length.

The lips of the tear being held apart by the index and second fingers of the left hand, the needle is introduced near the upper angle of the tear about half a centimeter, $\frac{1}{5}$ inch, from the margin. After having been brought out in the bottom of the tear, it is re-entered near this point, and emerges on the skin surface on the opposite side at a point corresponding to that of its first entrance. The next suture having been passed nearer the lower angle of the tear, both are tied, and the wound is almost completely closed. Two or three superficial sutures may be required to complete the approximation. During convalescence care should be taken not to make pressure upon the approximated surfaces with the finger or with the nozzle of the syringe, should a douche need to be given. The stitches may be removed about the eighth day. To do this the buttocks and labia are separated with the fingers and thumb, and the surface of the wound is cleansed by means of pledgets of cotton saturated with boric acid solution ; each suture, being caught in the dressing-forceps, is gently pulled forward until the loop is exposed, so that it can be cut close to the surface. The suture is withdrawn by making traction upon the end containing the knot, so that the smooth portion is drawn through the tissues.

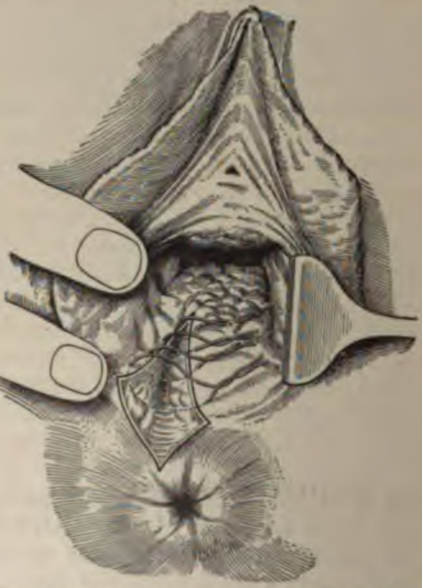
FIG. 370.



Superficial tear exposed by fingers parting labia minora.

2. **Combined Internal and External Tear.** In the second form of laceration the injury sustained during labor may appear as a gutter-shaped tear, which is generally in the median line on the skin surface, but within the vagina involves either one or both of the lateral sulci of the vagina. The laceration may vary in length from 2.5 to 5 cm., 1 to 2 inches, or may be even longer. It may be caused by pressure of the head or of the shoulder, the former in its descent producing a tear inside the vagina which may be further

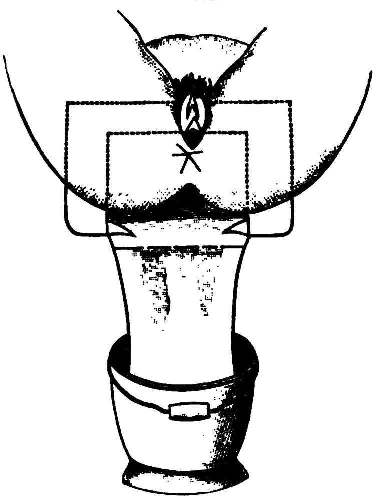
FIG. 371.



Superficial combined internal and external tear, showing portion of tear in vagina that may escape notice.

enlarged by the shoulder of the fœtus as it forces its way down between the levator fibres and their rectal attachments on one or both sides. In addition we generally have a superficial rupture of the fourchette. It not infrequently happens that this latter portion of the tear is the only one attended to, and that the most important part, being concealed within the vagina, escapes notice. (Fig. 371.) It is, however, the main injury to the supports of the vaginal outlet which should more especially be sought out and remedied. Immediate repair should be instituted. (Fig. 372.)

FIG. 372.



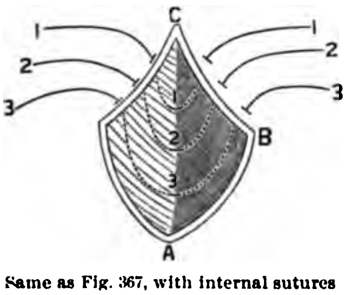
Patient in lithotomy position, on perineal pad, ready for the immediate operation.

METHOD OF OPERATING. The method of operating for the closure of recent internal tears is somewhat as follows: The patient should be placed in the position just mentioned when describing the suturing of a superficial laceration; the perineal drainage cushion (Fig. 370) should be placed under the buttocks, with the apron over the edge of the bed hanging into a bucket. In these cases it is generally better to give an anesthetic, unless the patient is confident that she can bear a moderate amount of pain.

The following instruments should be in readiness:

1. Needle-holder.
2. Small and medium-sized curved needles threaded with carriers.
3. Six strands of silkworm-gut.
4. One dozen medium-sized silk or catgut sutures.
5. Emmet's curved scissors, and the Sims' or Simon's speculum or a flat retractor. An Emmet's needle is by some operators preferred to the usual surgical needle. (Fig. 374.)

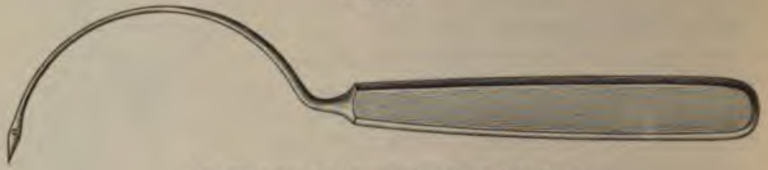
FIG. 373.



Same as Fig. 367, with internal sutures passed, ready to tie.

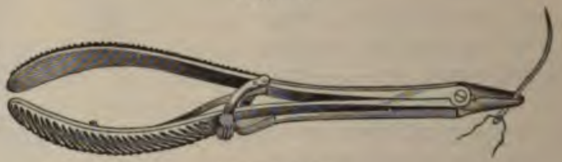
The anterior wall of the vagina being held back and the labia separated by the fingers of the left hand (Fig. 370), or by means of a speculum or retractor in the hands of an assistant, and the upper angles of the wound having been thus exposed, the first suture is passed just below the upper angle of the tear, and the next about a centimeter below this, and so on down to the other extremity. The needle should be introduced 5 mm. or more from the margin of the wound, since otherwise, if there is much contusion of the parts, the suture may cut through the weakened tissues. The direction in which the sutures are passed is a matter of some importance. The needle should be carried through the tissues in a direction toward the operator, and brought out at the centre of the tear; it is then re-entered and carried upward in a direction away from the operator to the point of exit, which should correspond with that of entrance. In this way the approximation will be much better than if the sutures are passed in a plane at right angles to the surface. The part of the suture seen in the floor of the wound lies 1 or 2 cm. nearer the perineal angle of the wound than the lateral points of entrance and exit. (Figs. 373, 377, 378, 379.) Immediately a suture has been introduced, it should be tied; or the ends may be clamped till all have been laid.

FIG. 374.



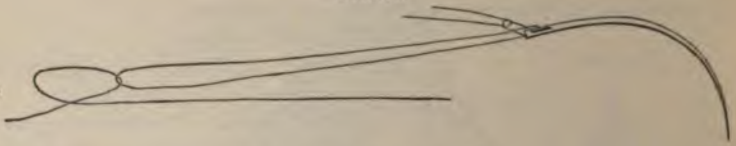
Emmet's needle for suturing the pelvic floor.

FIG. 375.



Needle holder.

FIG. 376.

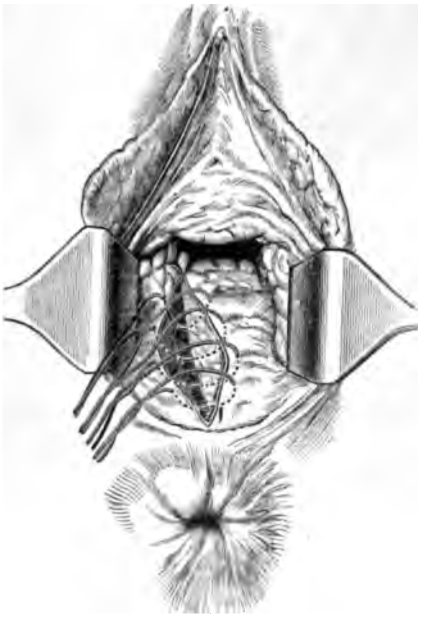


Needle armed with a carrier.

Near the vaginal outlet, the tissues being the least yielding just where the sutures enter the lateral wall, the part of the suture lying in the bottom of the wound is pulled upward. This is what we mean by a "lifting suture;" for it, silkworm-gut softened in sterilized water is the best material, being more elastic and smoother than either silk or silver wire, and less painful than the latter. On account of its elasticity it forms a symmetrical loop in the tissue, so that when the ends are brought together the constriction, which is often produced by the sharp angular loop made by silver wire, is avoided. Silkworm-gut, owing to its smoothness and non-absorbent quality, is not irritating, and sutures of this material may be left with safety in the vagina for several weeks.

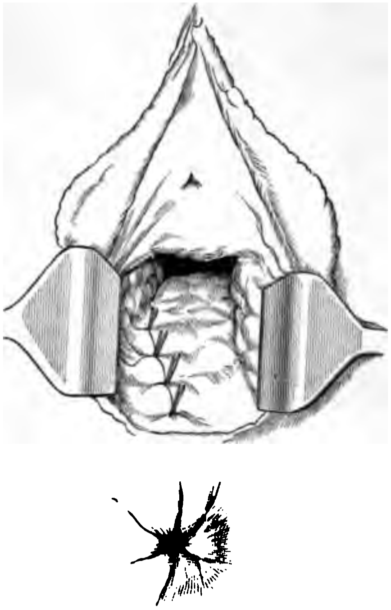
To insure success in this operation we must bring about the approximation of the torn structures within the vagina, and not only those on the skin surface. Two or three sutures introduced as described, with the belly of the sutures below the line of entrance and exit, will lift up a large tear, and approximate extensive raw surfaces and bring the torn edges of the fascia together in a most satisfactory manner. One or two superficial or half-deep sutures of fine silk on the skin surface will then complete the approximation. If, instead of adopting the method just outlined, all the sutures be passed from the skin surface in what would at first sight appear to be the natural curve beneath the lacerated tissue, it is only too probable that the really important part of the tear —viz., that within the vagina—will be left ununited. In this way a pocket is formed in the vaginal wall, in which secretions may collect, so that any attempt at union will be frustrated, and a troublesome perineo-vaginal fistula may even occur. In any case, although there may be good external union and the skin perineum be perfect, a relaxed outlet will surely be left.

FIG. 377.



Internal stitches in position.

FIG. 378.

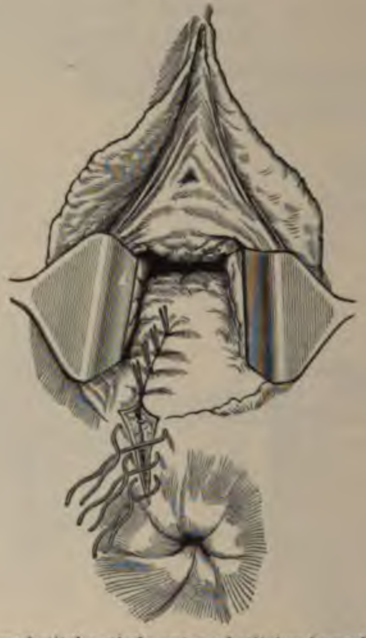


Internal stitches tied.

AFTER-TREATMENT. After the patient has been put to bed it will seldom be necessary to bind her legs together or make her keep strictly in the dorsal position. She may be allowed to turn slowly in bed, or even to elevate the knees, provided only that she keeps them together.

Catheterization may be necessary at intervals for the first day or two, on account of ischuria or retention, but the patient should always be encouraged to pass her urine voluntarily if possible. The bowels should be moved, after twenty-four hours, with citrate of magnesium or Rochelle salt given by the mouth. If there be straining at stool, the index finger should be anointed and introduced into the rectum for the purpose of removing any scybalous masses that may be present. After the urine

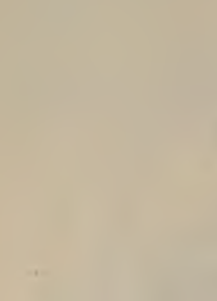
FIG. 379.



Internal stitches tied; external stitches in position.

has been passed the labia should be separated and 2 grams (ʒss) of iodoform and boric acid powder (1 : 7) may be dusted upon the wound. A pad of absorbent cotton is then applied, and held in place by a T-bandage. The sutures may be removed in from eight to ten days after the operation. The patient should be kept in bed from twelve to fourteen days, and should not be allowed to exert herself much for four or five weeks.

FIG. 380.



Sagittal-section of posterior vaginal wall, perineum, and rectum.

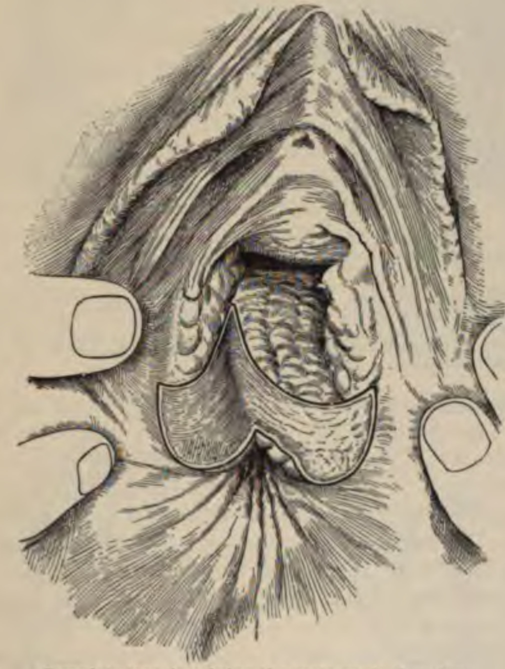
The area embraced by OU represents an outside, more or less superficial tear. The area above IN represents a tear more on the inside of the vagina, and the area outside of SO includes the whole skin perineum and sphincter ani.

3. **Complete Tear.** The third form of recent tear involving the rectum starts at the fourchette and extends back in the median line of the perineum through the sphincter ani, and to a variable extent involves the recto-vaginal septum. (Figs. 380, 381.) It must be remembered that the external tear occurs in the median line, while the internal rupture is always lateral, occurring on one or both sides. The function of the external sphincter muscle, when its fibres have been torn through, is lost, and as a result we may have incontinence of fæces and flatus. Yet such patients will often put off an operation for months

or years, until their condition is unbearable. An immediate operation is advisable in these cases, since, if it is successful, the patient will be spared much discomfort and misery. She saves time and the greater annoyance and suffering incident to a secondary operation. Again, immediately after labor there is less tension of the torn structures, owing to loss of muscle-tone.

METHOD OF OPERATING. The woman should be placed in the lithotomy position, as described above. The complex tear is first reduced to a simple one, by closing the rent in the bowel, which is a very important part of the injury. (Fig. 382.) Beginning at the apex of the tear, a series of interrupted catgut or silk sutures is inserted. Buried catgut sutures may advantageously be employed for this purpose. The first suture is introduced on the rectal side of the rupture, and it penetrates the tissues of the septum deeply enough (5 mm.) to ensure a firm hold. One turn of the first knot and two of the second will make it hold securely. The remaining sutures are passed in a similar manner until the ruptured sphincter is reached. It is not unusual to find that on one or both sides the torn ends of the sphincter have retracted, leaving a pocket. It is of the utmost importance that this condition be rectified; the ends of the muscle must be sought out carefully and brought into accurate approximation. A tenaculum may be employed to draw out an end of the retracted muscle, which is then secured by means of one or two catgut sutures passed through it. The other end having been caught, the sutures are passed through it and pulled tight,

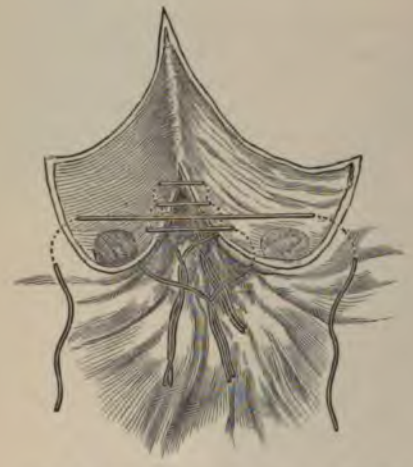
FIG. 381.



Complete tear, involving the recto-vaginal septum.

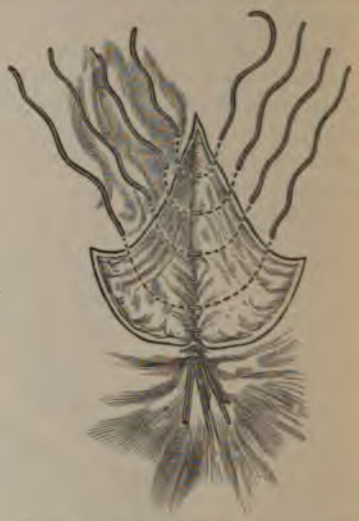
tied, and buried. To relieve undue tension upon these approximation sutures it is advisable to employ one or two silkworm-gut sutures, which

FIG. 382.



Complete tear; closing the rent in the bowel.

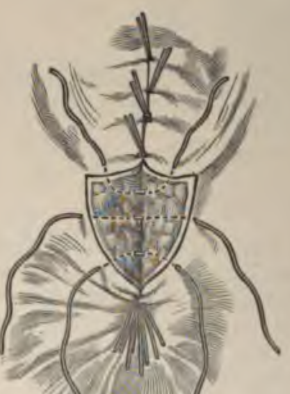
FIG. 383.



Deep interrupted lifting sutures in position.

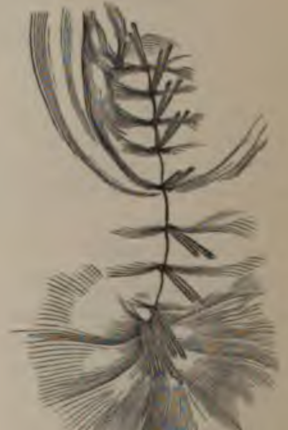
are made to enter and emerge in the muscle farther away from the torn ends and circle about 1½ centimeters above the angle of the tear up to the recto-vaginal septum.

FIG. 384.



All sutures laid; vaginal sutures tied.

FIG. 385.



Internal and external sutures tied.

After eliminating the rectal complication, we have left a tear such as has been described, involving the fourchette and usually extending a short distance upward in the median line, or into one or both sulci of the vagina. This part of the wound is closed by deep interrupted lifting sutures in the manner detailed when speaking of the second form of laceration. (Fig. 383.) After these sutures have been tied, it is advisable to employ a few superficial silk sutures to complete the approximation. (Figs. 384, 385.) To have union throughout, perfect approximation is necessary, and it is essential that the sutures be properly laid. In very deep lacerations it is sometimes advisable to use tiers of sutures, the first suture consisting of a running catgut suture laid in a plane near the bottom of the wound, and the next at a slightly higher level. The last tier may consist of interrupted silkworm-gut sutures, which are tied on the vaginal surface. An operation such as has been described will generally restore the relaxed outlet almost to its normal condition, if the parturient period has been properly conducted, so that puerperal sepsis is prevented. The repair may be postponed, and in some cases this has to be done, but only by an early operation can the parts be restored to their primitive integrity. All secondary operations are less efficacious.

AFTER-TREATMENT. The after-treatment is to be conducted in accordance with the general principles laid down elsewhere. The same rules as to the evacuation of the bladder and the bowels advised before and after other operations must be carefully carried out. Catheters can be sterilized by boiling for five minutes in a 1 per cent. soda solution. This procedure, however, is very deleterious to the ordinary rubber or gutta-percha catheter, and for this reason glass catheters are invaluable. Though they are sometimes broken in the boiling, this is of no great moment, as they are cheap, and by their use greater safety is insured.

In ordinary instances the nurse may be allowed to give the enema, but in cases of complete laceration the physician should take this duty upon himself. The index finger, smeared with vaseline, should be gently introduced into the rectum, in order to determine the exact direction of the canal; with this as a guide the syringe is carefully inserted and the injection is given slowly. This caution is not superfluous. More than once the point of the syringe has been thrust between the stitches passed through the perineum. One case is reported in which it was pushed through the coat of the bowel, and a laxative enema was forced into the pelvic cellular tissue. The patient died from the extensive sloughing which followed.

Straining during the act of defæcation must be avoided, and hard masses of fæces in the rectum must be removed by the finger of the physician. In doing this, pressure should be made toward the sacrum. As a rule, a vaginal douche is unnecessary. If the discharge is foul, but the patient has no fever, one consisting of a saturated solution of boric acid or of a 2 per cent. solution of carbolic acid may be employed, and if this procedure is followed by no improvement, the uterine cavity should be carefully explored and, if necessary, curetted.

A pad of absorbent cotton is applied loosely over the vulva; it is at first changed every two or three hours, and later three times daily.

All perineal cases must be kept in bed for two weeks; on the eighth day the external sutures are removed. The silkworm-gut sutures should be pulled out so that the wound surfaces are drawn together, rather than apart. The internal sutures can be removed at the end of two or three weeks.

IMMEDIATE REPAIR OF THE LACERATED CERVIX.

The primary operation for this condition is only rarely indicated. It is impossible for labor to take place without more or less extensive rupture of the cervical tissues, but even in cases of severe laceration, it has generally been thought better, as a rule, to remedy any defect later, rather than add to the severe trials of the woman at the time of labor by immediate operation. In instances of persistent hemorrhage from the circular artery, however, it may be necessary for the safety of the patient to repair the lacerated structures at once in order to stop the bleeding, and not a few cases are quoted in which life has apparently been saved by resort to this procedure. The most recent literature upon the subject shows an increasing tendency to undertake the immediate operation in less severe cases also, and when we consider the later dangers of a lacerated cervix to the patient and the natural repugnance that exists in many cases to the secondary operation, together with the serious consequences resulting from the neglected cervical injuries, the question arises whether it is not better to unite at once the raw surfaces and thus effect two purposes at once: (1) the closing of avenues by which infective material may enter, and (2) the avoidance of injurious results which may follow from the neglect to rectify the condition later. It is true that the tumefaction of the tissues may make it difficult to secure proper coaptation, but with a little care any objection to the procedure on this score may be overcome.

Method of Operating. The operation itself is comparatively simple. With the patient in the lithotomy position, the cervix is drawn down and held in position by means of a tenaculum or a volsella, and stitches are of about one inch apart from above downward. As careful approximation as possible should be obtained, a result which may be promoted, if necessary, by a few superficial stitches. A teaspoonful of iodoform and boric acid powder (1 : 7) may be dusted over the wound. The stitches may be removed about the twenty-first day.

CHAPTER XXX.

THE INDUCTION OF ABORTION AND OF PREMATURE LABOR.

Definition. Before dealing with the various means at our disposal for the artificial emptying of the uterus before term, it is necessary to discuss briefly the significance of some of the numerous terms which have been applied to the interruption of pregnancy. Zweifel distinguishes two main classes of cases: (1) those in which the ovum is usually discharged *in toto*, and (2) those in which the fetus is extruded after rupture of the membranes. Thus, he would apply the term *abortion* to expulsion of the ovum before the end of the sixteenth week, and that of *premature labor* to its expulsion between the beginning of the seventeenth week and full term. Although much can be said from an anatomical standpoint in favor of this classification, the fact remains that when operative interference is indicated the question whether we are dealing with a viable or a non-viable child is often of predominating importance as regards the selection of the method to be employed. For our present purpose, therefore, it will be more convenient to adopt a different division, and to consider *abortion* as a delivery of the fetus before it is viable—*i e.*, before the end of the twenty-eighth week; while the discharge of the uterine contents between this time and full term will be spoken of as *premature labor*.

Mention has already been made in another chapter of cases in which the exciting cause of abortion or of premature labor has been beyond our reach; but a very important class still remains, namely, those instances in which the physician himself, for good cause, finds it necessary to bring about the premature discharge of the contents of the pregnant uterus.

The induction of abortion or of premature labor in non-pathological conditions is rightly regarded in civilized communities as a moral and civil crime, and one to be punished with severe legal penalties. Although, therefore, it is generally agreed that medical science may on rare occasions be above the law, it is evident that it must always be the first duty of the physician to place both his patient and himself beyond the imputation of any intention to commit a serious crime. There should be no false modesty or concealment about the operation. Intentional secrecy may, unjustly, be looked upon as *primâ facie* evidence of criminality. When, however, the mother is in such physical condition that further continuance of gestation would be perilous to her life, it is generally conceded that interference with pregnancy is not only justifiable, but a solemn duty. But so serious a course should never be decided upon by one physician alone. To demonstrate absolutely the absence of criminal intent should be his first thought. This end may be best accomplished by calling in consultation a colleague, and not proceeding to operation until the necessity for it has been carefully demonstrated, a full explanation of the circumstances of the case has been made to the members of the family more directly concerned, and the course to be pursued has met with their full approval.

The first point to be considered in deciding whether an interference with gestation is necessary is the physical and mental condition of the mother. Should it seem to the physician, after careful thought and consideration of the particular case, that the woman's life will be seriously threatened by allowing the pregnancy to continue to term, the next question to be decided is, whether it may not be possible to wait until there will exist some chance for saving the life of the infant as well; in other words, whether we ought to bring about an abortion or a premature labor.

Indications. Among the conditions in which interference with gestation may be justifiable are the following:

1. Death of the fœtus in utero.

2. Grave pathological conditions of the viscera, such as advanced cardiac disease, phthisis which is clearly making rapid progress on account of the pregnant condition, kidney lesions threatening eclampsia, and persistent and advancing jaundice. An acute nephritis is especially dangerous when it occurs during pregnancy, and experience has shown that the emptying of the uterus has often cut short the process.

3. In the vomiting of pregnancy which has resisted all other measures, and where the patient's strength is rapidly failing, the induction of abortion may be necessary as a last resort. Still, it is only right to wait as long as we dare, and sometimes to give the stomach long intervals of entire rest, the strength of the patient being partially supported meanwhile by nutrient enemata. The various surgical procedures which have been tried are very rarely of any use in these cases. Occasionally applications to the cervix have appeared to be beneficial, and Martin states that dilatation in his hands has been successful; yet Runge holds that this method is absolutely unreliable.

4. Certain diseases of the blood and of the nervous system—*e. g.*, pernicious anæmia, leucocythæmia, acute melancholia, acute mania, and inflammatory affections of the brain—apparently depending upon the pregnancy or increased by it. In pernicious anæmia Bischoff prefers the induction of premature labor, and denies that abortion is necessary; he argues that anæmia becomes dangerous only during the latter half of pregnancy.

5. Where the mechanical conditions are such that the birth of a viable child becomes an impossibility; for example, in cases of retroflexion of the gravid uterus with incarceration below the superior strait, or an abnormally small calibre of the vagina such as would prevent the passage of the child. Again, the presence of benign or malignant tumors which would effectually preclude delivery of a child at term through the natural passages, and hernia of the uterus resisting all other treatment bring up the question of the advisability of putting an end to the pregnancy.

When the uterus is retroflexed
tempts, even under narcosis, to
proved ineffectual, the indica

these cases, however, it is always the duty of the attending physician to weigh carefully the question how long it may be safe to delay emptying the uterus; and if it be possible, without grave risk to the mother, to wait until there is a chance of securing a living child, interference in the later stages of pregnancy should be preferred. Under some circumstances in cases of narrowing of the vagina, where the smallness of the calibre is due to cicatrices, lateral incisions or other operations may be indicated. In cases of obstruction, from whatever cause they may arise, the question of Cæsarean section with its various modifications should always be taken into consideration.

Methods of Inducing Abortion.

The mechanism of the premature discharge of the contents of the pregnant uterus resembles in the main that of normal labor. In bringing about the expulsion by artificial methods we should, as far as possible, imitate nature, the essential element in the operation being to secure contractions of the uterus and the consequent evacuation of the organ. The process is really a reflex act, implying the application of a stimulus and a conveyance of it to nerve-centers, from which an impulse is sent down to the peripheral nerves which causes the uterus to contract.

Such a reflex act may be brought about in various ways, and the seat of the original stimulus need not of necessity be the uterus itself. It has long been known that irritation applied to the breasts, and more especially to the nipples, is often followed by uterine contractions of greater or less intensity. This fact has been taken advantage of by Scanzoni, who has formulated a method of inducing abortion by irritation of the nipples. But, as might be expected, the strongest and most effectual contractions can be brought about by the application of the stimulus directly to the interior of the uterus.

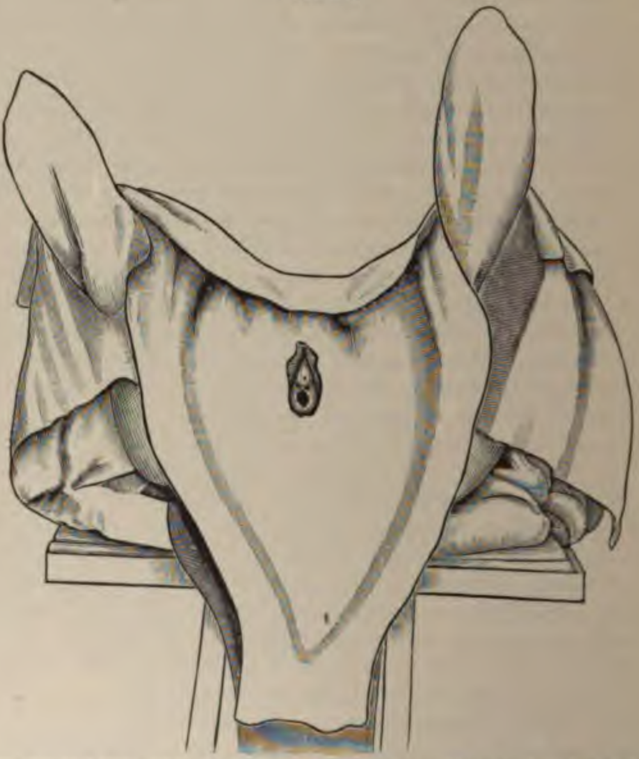
Stimuli may be distinguished as (1) chemical, (2) mechanical, (3) thermic, (4) electrical. An accurate classification along these lines, however, presents great difficulties, since some stimuli may act in more than one way. For instance, drugs may have a chemical and a mechanical effect and hot water injections may act as a mechanical as well as a thermic stimulus. For practical purposes stimuli may be conveniently discussed in three main classes: (1) Drug stimuli. (2) Stimuli applied to some region other than the interior of the cervical canal or the uterine cavity. (3) Stimuli applied directly to the interior (a) of the uterine cavity or (b) of the cervical canal.

1. *Drugs.* Many drugs have been employed for the purpose. Among the chief of these so-called ecbolics are ergot, cotton-root-bark, quinine, pilocarpine, the smut of Indian corn (ustilago maidis), and various essential oils, especially those of savine, rue, parsley, tansy, and pennyroyal. Of all these the most effective is undoubtedly ergot, which is capable of bringing on, as well as of strengthening, uterine contractions. But the contractions excited by ergot have a tonic character in contradistinction to the normal clonic or recurrent contractions which it should be our aim to secure. Thus, even when given in quite large doses, it often fails to accomplish fully the object in view, and operative interference may become necessary to complete the evacuation

of the uterus. Of the other drugs of this class, it may be said that their action is even more uncertain than that of ergot, and the exhibition of them in doses sufficient to cause abortion is always accompanied by considerable risk and even danger to the life of the patient. Oil of tansy and oil of rue are much relied on by the laity for the production of abortion, and almost every day one may read of fatal results attending their use. Oil of tansy in large doses is said to excite epileptiform convulsions; quite recently one of my colleagues met such a case in his practice.

Abortion has been brought about by reflex stimulation of the uterus through free purgation. Magnesium sulphate in heroic doses has not infrequently been used for this purpose. Its action, however, is quite uncertain, and nothing can be said in favor of this method. It is probable that the irritant purgatives have much more effect, but their use in sufficient doses is highly dangerous. It is more than possible that oil of tansy and oil of rue act in this way. In brief, it may be said that the employment of drugs for bringing about the evacuation of the uterus should be entirely discarded. Their action is uncertain and slow, and in effective doses their use is always accompanied with danger.

FIG. 386.

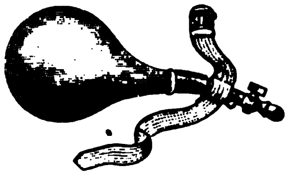


Field of operation and the neighboring parts protected by gauze diaphragm, towel and stockings.

2. *Scanzoni's method*, which consists in massage or rubbing of the nipples, is uncertain in its action and sometimes exceedingly painful to the patient. It is not to be recommended.

Tamponade of the vagina is very effective in some cases, and, as has been said, is often employed in cases of inevitable abortion to stop the hemorrhage and to bring about dilatation of the cervix and contractions of the uterus. The tampons may be made of gauze or cotton, or the colpeurynter more especially recommended by C. Braun may be employed. The external parts having been carefully disinfected, the vagina is first rendered as aseptic as possible by flushing with several douches; it is then washed with soap and water, a cotton sponge being used, and afterward with a 2 per cent. solution of creolin, followed by a 1 : 1000 solution of mercuric chloride. After having been finally irrigated with an abundance of normal salt solution, it is dried with small pledgets of aseptic absorbent cotton. In the further steps of the procedure it is advisable to employ a sterilized gauze perineal apron, the operator working through a slit in it which corresponds to the vulvar opening. Two or three tampons of sterile absorbent cotton, or of 10 per cent. iodoformized or plain sterile gauze, are then introduced on either side of the cervix, and are held in position for several minutes, moderate pressure being employed. After this a fresh tampon is introduced, which is followed by others until the vagina is completely filled. (Fig. 386.) Dry tampons stay in place much better than those which have been soaked in disinfectant solutions, and are quite as efficient. In the place of these tampons the colpeurynter may be employed. (Fig. 387.) The tampons or colpeurynter should not be allowed to remain in position more than twenty-four hours. After their removal a 2 per cent. solution of carbolic acid may be employed as a douche. In view of the fact that in susceptible patients poisoning has been sometimes produced by carbolic acid, many authorities prefer to use sterile normal salt solution. If the first tamponade does not produce the desired effect, a second or even a third may be employed. The method is usually effective, but it has the disadvantage that it is almost always slow and not infrequently painful.

FIG. 387.



Colpeurynter.

Kiwisch's method consists in the injection of warm water against the cervix. He recommends the use of a fountain syringe and water at a temperature of about 42.5° C. (106° F.). The douche is given two or three times daily for fifteen minutes at a time, the stream being directed against the cervix. Care must be taken not to inject air into the cervical canal. The heat of the water and the force of the stream are important factors in this method, which, although slow, is often effective.

Electricity. The use of the galvanic current has been strongly recommended by some authors. The positive pole is applied over the sacral region or over the lumbar vertebræ, and the negative pole is applied to the exterior of the cervix in the posterior cul-de-sac. The method has not, as yet, been much employed.

3. (*a*) *Krause's method* consists in introducing a flexible elastic bougie between the wall of the uterus and the membranes. The procedure has been modified in various ways. Some authorities allow the instrument to remain in place from twelve to twenty-four hours, while others hold that it should be introduced and then immediately withdrawn. Bougies are preferable to catheters, since in the employment of the latter there is danger of introducing air into the uterine sinuses. The instrument must be soft and flexible, otherwise there is great risk of perforating the amniotic sac, or even the uterine wall itself. Steel sounds should not be employed. Strict asepsis of the external genitals and vagina and of the hands of the operator and his assistants is to be observed.

The procedure may be carried out as follows: The cervix being thoroughly exposed, the bougie is pushed gently in until the tip lies near the fundus. After being allowed to remain for several minutes it is withdrawn, and the vaginal canal is packed with tampons; or the bougie may be left *in situ* and the tamponade of gauze be made around it. Should there be much hemorrhage, evidenced by blood flowing down along the bougie, so that we have reason to suspect that the placental site has been invaded, the bougie should be withdrawn and reinserted in another direction. The hemorrhage will then probably cease spontaneously. If, however, it becomes alarming, a firm vaginal tamponade may be made, or preferably a colpeurynter may be inserted into the vagina close up to the cervix and allowed to remain for some hours, unless indications for its removal should appear. This method is not to be recommended during the first two or three months, but in the later stages of pregnancy it is one of the most satisfactory which we possess. It usually acts promptly and effectively. The operation in a crude form is often resorted to by women in order to free themselves from the consequences of pregnancy, frequently with disastrous results, which are due almost always to infection following a total lack of asepsis. It is also in vogue among the unsavory class of men and women known in communities as "abortionists."

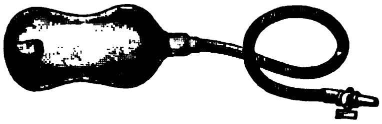
Hamilton's method consists in the circular detachment by means of the finger of the fœtal membranes for a short distance above the internal os. The employment of this method presupposes a dilatation of the cervical canal so that it is capable of admitting a finger. Its action is similar to that of Tarnier's method, but is not so certain.

Tarnier's method consists in the insertion of a dilatable rubber bag into the cervical canal and extending slightly above the internal os. The distention of this bag with water, and the subsequent separation of the membranes from the decidua for a certain distance above the internal os, excite uterine contractions, with a coincident dilatation of the cervix. Except that in Tarnier's method the bag is inserted somewhat higher up, the procedure differs in no essential respect from that of Barnes.

The advantages of this method consist in the preservation of the bag of waters, and in the simultaneous induction of uterine contractions and of dilatation of the cervix.

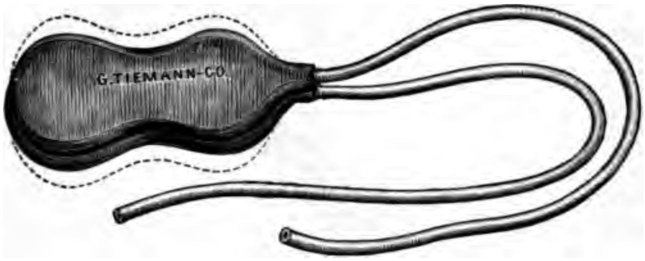
In using any of these rubber bags it is necessary that the material be new and be well preserved, otherwise they will be very apt to rupture when distended and thus allow a quantity of water to get into the uterus. They should be rendered thoroughly aseptic, both inside and outside, before being employed, and the water used for filling them should previously have been boiled, so that if rupture takes place no great harm may be done. This method usually acts quickly and thoroughly, and is especially to be recommended in pregnancies between the third and the end of the sixth month. (Figs. 388, 389, 390, and 391.)

FIG. 388.



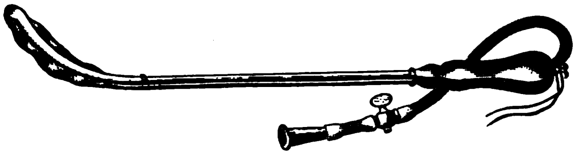
Barnes' bag.

FIG. 389.


G. TIEMANN-CO.

McLean's bag.

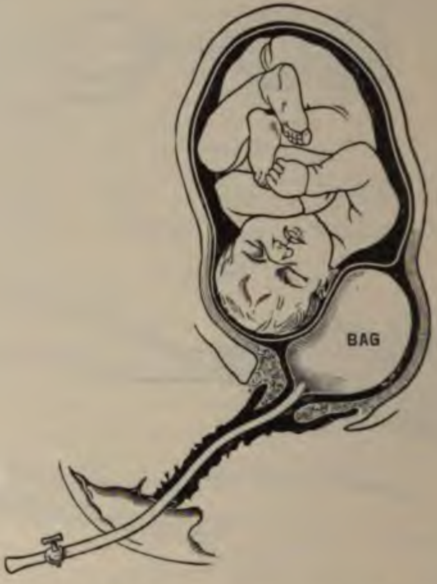
FIG. 390.



Tarnier's uterine dilator.

Cohen's method consists in the injection of fluids between the membranes and the uterine wall. No special apparatus is necessary, since one which will serve all purposes can readily be improvised. The nozzle of the syringe or douche bag should be from $\frac{1}{8}$ to $\frac{1}{4}$ inch, 0.31–0.62 cm., in diameter, and from 6 to 8 inches, 15–20 cm., in length. It is better to employ a sterilized piston-syringe, which will admit of the injection being made more gradually. The nozzle should be introduced carefully and the fluid injected slowly, so that rupture of the membrane may be avoided. From 1 to 3 ounces, 30–90 cc., of the sterile solution will probably be sufficient. The apex of the nozzle should be passed about two inches, 5 cm., up the cervix beyond the external os. The distance will, of course, vary according to the duration of pregnancy and consequent size of the uterus. All air must be expelled from the apparatus before the insertion of the nozzle. Should the desired effect not follow in the course of six hours, the injection may be repeated. The method is not to be recommended. Septic infection has often been observed, much more frequently than after employment of the majority of the other methods. Cases of thrombosis and embolism have also been reported, possibly due to the injection of air into the uterine sinuses. The advantages offered by it are that it is not only prompt in its action, but also very certain.

FIG. 391.

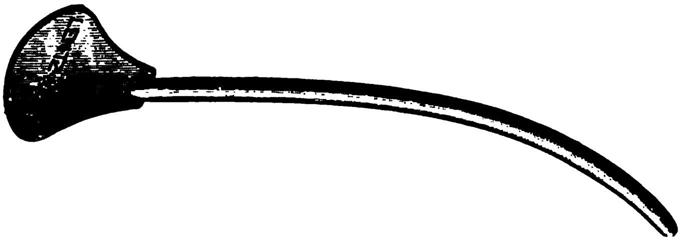


Tarnier's uterine dilator *in situ:* the bag is round in shape, but is compressed by the intra-uterine tension.

Scheel's method, with its modifications, depends upon the drawing off of the amniotic fluid, thus causing a more or less extensive separation of the membranes from the decidua and rendering the ovum a foreign body, which must naturally excite uterine contractions. The point selected for penetration or rupture of the membranes may be at the internal os, or higher up, so that a valvular opening is obtained. It is advisable to prevent, as far as possible, the entrance of air into the cavity of the amnion, since it is impossible to say how long it may take before the pains set in and the process terminates. Sometimes labor-pains come on in two or three hours, but at other times their appearance may be delayed for as many days. In the latter case there is danger that septic infection may follow the admission of air. Scheel's is probably the most certain of the methods employed for the induction of labor, but it possesses several disadvantages, not the least of which is that in almost every case its employment is followed by a dry labor, if the membranes are punctured at the internal os. The fact that the amniotic fluid has escaped, and thus left a solid mass, the fœtal body and membranes, to be expelled by the uterus, renders the dilatation of the cervix a slower and more painful process. The contractions of the uterus are to a great extent ineffective, the laws of hydrostatics no longer applying, since the uterus now contains solid and not fluid contents. Again, it has been found that not infrequently portions of the membranes are left in the uterus. The former of these objections can be overcome by adopting the modifications suggested and carried out by Hopkins and Meissner. They make the puncture some distance above the internal os, so that enough of the amniotic fluid drains away to bring on uterine contractions, while sufficient still remains behind to be of value in dilating the cervical canal for the after-coming parts of the ovum. In advanced pregnancy it is best to allow the water to drain off slowly. Various kinds of instruments, from a simple pin or finger-nail to a complicated aspirating-needle, may be made use of.

(*b*) *Dilatation of the Cervical Canal.* This may be accomplished in many ways. It may be called for as the introductory step in carrying out other methods—*e. g.*, Hamilton's—where it is necessary to gain entrance for the finger to the uterine cavity. The cervix may be dilated, if it is soft enough, by means of the finger, by Barnes' bag, or by metal or hard-rubber dilators. Dilatation by means of the Barnes' bag is effective and comparatively safe and speedy. It is more applicable to the induction of premature labor than of abortion. Digital dilatation is in early cases a difficult procedure. Moderate dilatation with easily sterilized metal or hard-rubber dilators is generally to be preferred. (Fig. 392.) Though not always effective, it succeeds in the majority of cases, and has the advantage of being one of the safest methods known.

FIG. 392.



Hegar's dilator.

When the patient presents herself in the first two or three months, and the necessity for putting a stop to the pregnancy is absolute, the swiftest and surest method in the hands of a skilled operator is by means of dilating and curetting. The procedure resembles somewhat that pursued in gynecological cases. The cervix is dilated with a steel branched dilator to a half or a full inch. The ovum is then separated, if possible, with a dull curette, and the whole is withdrawn with uterine dressing-forceps. The cavity is then gone over carefully with a sharp curette. Frequently the ovum has to be brought away piecemeal. The whole operation can be done in from ten to twenty minutes. It is absolutely sure, and with proper precautions should never be dangerous.

Methods of Inducing Premature Labor.

For this purpose it is possible to use any of the methods which have been spoken of in dealing with the induction of abortion. But, as has already been said, in this connection, a new factor is encountered, namely, the possibility of obtaining a viable child, while at the same time the mother is relieved of a dangerous encumbrance. Whereas in the former case the fœtus may be regarded as a foreign body, to be gotten rid of by the means most conducive to the welfare of the mother, it now presents itself as a living being, whose life may be put nearly on a par with her own. In choosing methods, then, we are restricted to those which will give the infant the best chance of life consistent with the safety of the mother. For this reason methods such as that of Scheel, which depend upon the withdrawal of the liquor amnii, are not advisable. Since their use entails a "dry labor," they increase to some extent the risks to the child. It will perhaps be more convenient to state, first, the procedure at present adopted by most of the prominent obstetricians in this country, and then to speak briefly of the advantages and disadvantages of the other methods.

Operation. The cervix is dilated gradually to one inch with a steel branched dilator. The membranes are then peeled up from the lower uterine segment with a uterine sound or with the finger. This step has been recommended by Jewett, and in the hands of a skilful operator it would seem to facilitate matters a good deal. One or two bougies (English No. 10 or 12) are then passed between the uterus and the membranes. The proximal end of the bougie having been cut off and a stylet introduced, the bougie is passed up as far as it will go, the lower end, if any remains outside, being seized with a Keith's forceps and carried into the uterus bit by bit. The cervix is then packed with gauze. Instead of the bougies and gauze, one of the bags recommended respectively by Champetier de Ribes, McLean, and Barnes, may be used. Labor is usually completed in from twenty-four to thirty-six hours. In urgent cases the dilatation may be completed with the hands, or, after the os internum is obliterated, by means of water-bags. In extreme emergencies Dührssen's incisions may be employed after the os internum is effaced. But, contrary to the practice of this author, the incisions should be sutured immediately after labor.

With respect to the other methods, it may be said that the use of drugs is most emphatically to be condemned. Scanzoni's method is uncertain and painful, and possesses only historical interest. Tamponade of the vagina is a fairly reliable and a safe method. In placenta prævia the colpeurynter is to be preferred. Both these and Kiwisch's method are slow in their action, but they offer the advantage of preserving the membranes unruptured. Krause's method is one of the best which we possess,—more especially if care be taken not to puncture the membranes. Hamilton's method and Tarnier's method are reliable, and are comparatively easy to carry out. Cohen's method is equally certain, but it is not so simple a procedure, and is objectionable on account of the danger of the injection of air into the uterine sinuses. Scheel's method and its modifications have the disadvantages attaching to a dry labor, but when the fœtus is dead and the case is not urgent it is one of the best at our disposal. It is often slow in its provocation of uterine contractions, but when these have been once established delivery as a rule is speedy. Although many living and viable children have been born in cases in which it has been employed, when the chances for the child's life are weighed the method must be considered inferior to those in which the amniotic membranes are left intact. The employment of tents, apparently even under the most aseptic precautions, for dilatation of the cervical canal has often been followed by infection. Tarnier's procedure is better, and is not difficult to carry out. Digital dilatation is comparatively simple, and, although sometimes slow, has been effected in an hour or two by many operators. In general, therefore, it may be said that in urgent cases—*e. g.*, in eclampsia—where it is necessary to empty the uterus as quickly as possible, the method first described, or some modification of Tarnier's procedure, is to be preferred. In cases of placenta prævia with severe hemorrhage the colpeurynter is highly efficacious. When the case is less pressing it is always advisable to be content with gradual dilatation, and to leave the bag of waters unruptured till later. All other things being equal, the method should be chosen in which the individual operator has the most experience. The procedure of Krause and Tarnier and the employment of the colpeurynter are all applicable.

After the expulsion of the ovum in abortion or premature labor the membranes and placenta should be minutely examined, and we should make sure that the uterus has been completely emptied. If this has been done, and if all the necessary manipulations have been carried out with strict aseptic precautions, a normal puerperium may be expected. The management of such cases is similar to that after spontaneous labor.

Retained and Adherent Placenta.

It occasionally happens that the birth of the fœtus is followed almost immediately by the delivery of the placenta. But, as a rule, from ten to thirty minutes may be devoted to the necessary care of the mother and child, while the expulsion of the placenta is awaited. During this time the uterus should carefully be watched, the hand of the nurse or doctor being kept on the abdomen to control the fundus.

Retained Placenta. Not infrequently the uterine contractions, together with the pressure exerted by the abdominal muscles, fail to cause the delivery of the placenta, which in such cases is usually found resting in the uterus. To such a condition the term *retained placenta* is applied.

Adherent Placenta. More rarely the placenta is not only retained *in utero*, but it remains fastened to the uterine wall. To this condition the term *adherent placenta* is applied. Of necessity, an adherent placenta must also be a retained placenta, but since the converse is by no means true, for the sake of simplicity, in describing the methods of dealing with such cases, it is more convenient to keep the two conditions distinct.

Mechanism of Placental Separation. To obtain a clear idea of the subject it is necessary to understand the mechanism which brings about the natural detachment of the placenta from the uterine walls.

The chief factor is the expulsive force of the uterine contractions. As the uterus becomes smaller the area of the placental site is lessening, tending to separate the placenta from its attachment. The expulsion of the placenta may take place in either of two ways. The first few contractions of the uterus after the completion of the second stage may be sufficient to loosen the placenta entirely, and to expel it folded lengthwise of the uterus in a more or less fusiform shape. They may not, however, detach the whole placenta, but only its central portion. The marginal attachment may still remain, blood collecting in the cavity formed between the central portion of the placenta and the uterine wall. The blood-accumulation, together with further contractions of the uterus, then forces the placenta down through the opening in the membranes, so that it emerges by its amniotic surface from the outlet, dragging the membranes after it. In either case, normally all the placenta, together with the membranes and the superficial layer of the decidua, should be expelled.

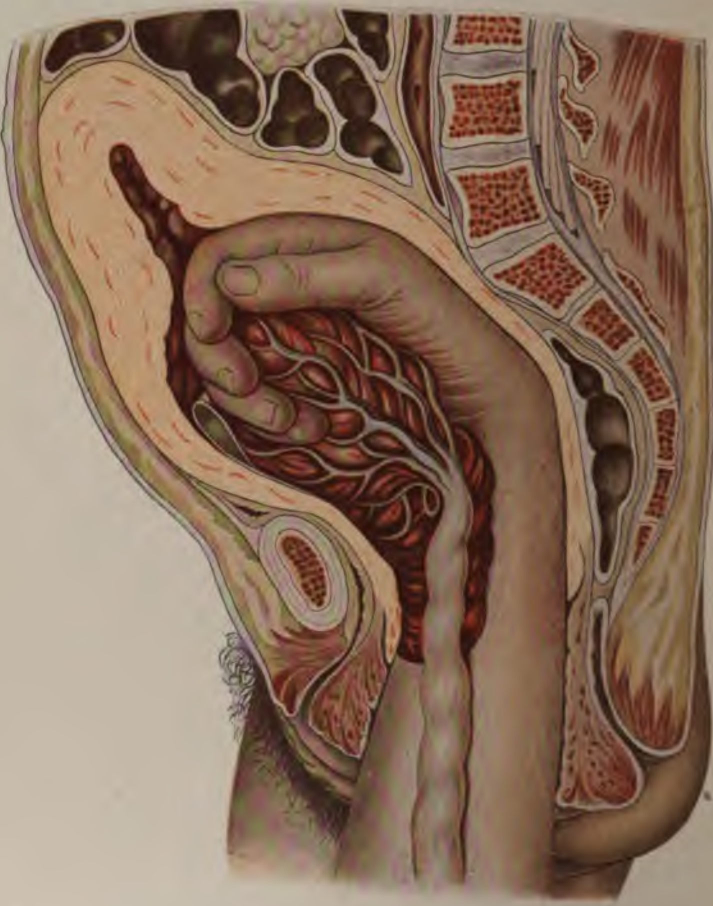
Causes of Retention of the Placenta. The placenta may be retained in the uterus by reason of feeble contractions, or, in other words, from inertia uteri. A full bladder, a rectum packed with fæces, or a pelvic tumor may act reflexly to prevent the efficient action of the expulsive forces. Sometimes, though wholly expelled from the uterine cavity, it may still be retained in the roomy vaginal vault.

Causes of Adherent Placenta. One of the most frequent factors leading to adhesion of the placenta to the uterine wall is syphilis. A non-specific placentitis is a very rare condition, and when present it may lead to adherent placenta. A chronic endometritis is sometimes responsible for this complication.

Treatment of the Retained Placenta. It is a cardinal rule, as a precaution against infection, to allow nothing, whether finger or instrument, to enter the uterus or vagina after labor, if possible to avoid it. The risk to the patient, even in these days of asepsis, is greatly increased by manipulations within the passages at this period. Should the expulsion of the placenta be delayed beyond half an hour, it is well to try, first, the effect of emptying the bladder. It not infrequently happens that, although it may have been carefully emptied before, the bladder becomes distended during the progress of the second stage of labor, and its evacuation may succeed in evoking vigorous uterine contractions and the prompt expulsion of the placenta.

If it be quite certain that the bladder and rectum are empty, Credé's method of expulsion should be tried. Traction upon the cord is not permissible. When the placenta is not yet detached from the uterus, pulling upon the cord may cause a partial separation, with alarming hemorrhage. Rough traction may even result in complete inversion of the uterus. If the use of Credé's method does not prove successful at the first attempt, it may be employed repeatedly and patiently at intervals, but no violence should be used. Well-directed manipulation according to Credé's method rarely fails if the fundus is carried well backward to bring the uterus nearly in line with the vaginal axis, and the woman is requested to "bear down" forcibly during the manipulation. As the placenta is being delivered, the membranes should be twisted gently into a cord and the whole slowly withdrawn. This pro-

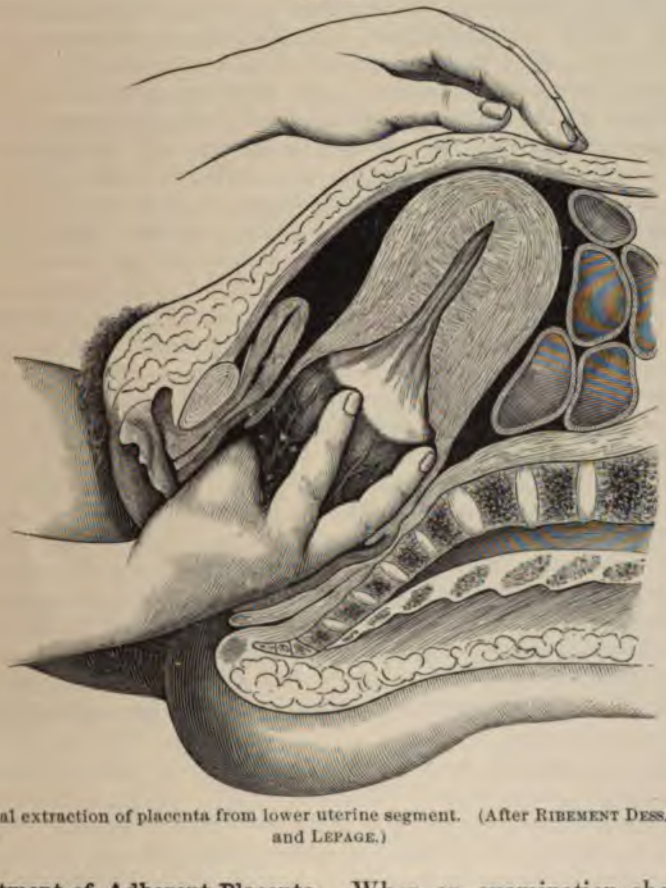
PLATE XXXVI.



Manual Extraction of Placenta.

cedure facilitates their removal and tends to prevent leaving behind fragments that may favor hemorrhage or infection. If expulsion be not effected by expression after a thorough trial, it will be necessary to institute a careful examination, in order that the cause of the retention may be determined. Should the placenta be found lying in the upper part of the vagina, it can be withdrawn gently by means of one or two fingers pushed up past it and then hooked over its upper margin. The extraction may be assisted by pressure from above through the abdominal wall.

FIG. 393.



Manual extraction of placenta from lower uterine segment. (After RIBEMENT DESSAIGNES and LEPAGE.)

Treatment of Adherent Placenta. When an examination shows that the placenta still remains in the uterine cavity notwithstanding the manipulations that have been described, we may reasonably suspect adherent placenta, and should take steps at once for bringing it away. In pre-antiseptic days the expectant treatment may have been allowable in view of the fact that the removal of the adherent placenta was considered, and justly so, a dangerous operation, the mortality being from 7 to 9 per cent. of cases so treated. The patient and persistent use of Credé's method may bring about the separation and expulsion of a moderately adherent placenta. Where this has not succeeded after one or two hours, or earlier if hemorrhage is occurring, we must proceed to extraction. Chloroform or ether should be administered to light secondary anæsthesia, and the outer genitals of the woman and the hands and arms of the surgeon should be rendered as nearly as possible sterile. The cord is taken in the left hand and gentle traction is made till the slack is taken in; the right hand and forearm are inserted into the vagina, the fingers following up the umbilical cord as a guide to its insertion. The so-called hourglass contraction, formerly so much spoken of as interfering with the manual extraction of the placenta, is caused by the meeting of the dilated or easily dilatable lower uterine segment with the more firmly contracted and less dilatable upper segment at the retraction-ring. Should there be trouble at first in entering the uterus, either at the cervix or at the site of the retraction-ring, it can generally be overcome by the patient application of gentle pressure. The edge of the placenta having been found, the fingers are gradually worked under it, and sweeping movements are made until the adhesions are broken up. The procedure may sometimes be facilitated by inserting two fingers held widely apart between the placental surface and the uterine wall, and then bringing them together like the blades of a pair of scissors. In the meantime counterpressure should be made through the abdominal walls upon the fundus, either with the operator's left hand or by an assistant. It must be insisted again that all attempts at extraction by pulling on the cord be avoided. After all the adhesions have been broken up, the margin of the placenta is carefully caught by a finger, and the whole mass lying on the palm of the hand can be forced out of the uterus. A careful examination of the membranes and of the placenta should then be made by an assistant, to learn if fragments have been left behind. It is better that, before removing his hand from the uterus, the operator make sure that the evacuation has been complete. Should fragments still remain in the uterus they should be at once removed by the hand, which may be supplemented, if need be, by the curette. These manipulations should be followed by an intra-uterine douche of normal salt solution, care being taken that no air is introduced. One or more full doses of ergot are usually advisable after the evacuation of the uterus has been completed.

CHAPTER XXXI.

THE FORCEPS.

THE obstetric forceps[1] is essentially a pair of steel hands for grasping the fœtal head and extracting it from the birth-canal in certain emergencies in which the natural powers are inadequate.

The invention is generally credited to Peter Chamberlen, an English obstetrician. It was for many years kept secret by the Chamberlen family. The instrument of Chamberlen consisted of two arms with the blades shaped to fit the fœtal head. The arms crossed each other, articulating at the point of intersection.

In 1723 Jean Palfyn, a professor of surgery at Ghent, presented to the Academy of Science at Paris an obstetric forceps with parallel arms articulating at the lower ends. In both the Chamberlen and Palfyn instruments the cephalic ends were provided with a single curve only, and that on the flat, in conformity with the shape of the head. Levret, in France, and Smellie, in England, at about the same time (1747 to 1751) introduced important improvements in the forceps, chief of which was a second curve, adapting it to the curvature of the pelvic axis. On their patterns are based the various models in use at the present day.

The obstetric forceps, however, is an invention of much greater antiquity than is generally supposed. Crude patterns of forceps are known to have been in use several centuries before the Christian era.

Description. The modern obstetric forceps consists of two interlocking crossed arms or branches. The arms are distinguished as left and right, the one passed on the left side of the pelvis being the left arm, and conversely. Each has four parts—handle, lock, shank, and blade.

The handles when the arms are locked fall together so as to be both conveniently grasped by one hand of the operator. They are sometimes made smooth, but for a more secure hold are generally roughened or corrugated on their outer margins. A knob at the lower end adds to the security of the grasp. There is usually a transverse projection at the upper end of each handle over which a finger may be hooked when making traction. An adjustable screw or other device between the handles, to limit the compressed action of the blades, as provided in some forceps, is of doubtful utility. The regulation of the pressure upon the head during traction is a matter which is better left to the judgment of the operator. The handles are best made of metal, or other material which will admit of sterilizing by heat.

The blades in the prevailing patterns of forceps have a double curve —a cephalic and a pelvic. The former adapts them to the shape of the fœtal head, the latter to that of the birth-canal.

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[1] The word "forceps" is a singular noun; the use of the term as plural is a common error, and it is equally erroneous to speak of a pair of forceps when only one instrument is meant.

The cephalic curve is essential to all midwifery forceps. It is somewhat elliptical rather than circular, since the former better accommodates itself to heads of different sizes. The head curve in best models is from 15 to 18 cm., 6 to 7 inches, in length. This gives room for the largest possible cephalic seizure. When the instrument is locked the greatest distance between the blades should be about 7.5 cm., 3 inches. With a smaller interval blades of proper length would be too nearly straight, and their hold upon the head insecure; with a greater width the maternal soft parts would be needlessly exposed to injury.

The interval between the tips when the instrument is closed should not be less than 25 mm., 1 inch, otherwise the child's head may be injured.

It is desirable that the point of greatest divergence between the blades be not more than 7.5 cm., about 3 inches, from the tips, since the head is pressed toward the tips during traction and would be exposed to injury if the interspace at the upper part of the blades were too narrow; moreover, rotation would be hindered.

The pelvic curve of the blades should be such that when the closed instrument lies on its back, on a plane surface, the centre of the tips shall be about 8.8 cm., about 3½ inches, above the plane. A greater curvature is better suited to high and a lesser one answers for low operations. But for general use an average pelvic sweep is required. In the usual pattern the cephalic and the pelvic curves are nearly equal. A third or perineal curve, to be found in some obsolete patterns, is cumbrous and useless.

The shanks connect the handles and blades and are necessary to give the length required for high operations.

The lock in all models of forceps is based either on the Smellie or the Levret model. The former is constructed on the principle of a mortise and tenon; in the latter there is on the left or lower half a thumb-screw, or a pin surmounted by a button, and in the edge of the other half a notch into which the pin or screw fits. It is essential that the articulation be loose enough to permit locking easily, yet at the same time it should hold the arms securely in proper relation with each other. Obviously the farther the lock from the handle, the greater will be the leverlike action of the forceps in compressing the head. It should be so located as to permit a sufficiently firm grasp of the head without undue pressure upon it. To this end it is usually placed about one-third way from the proximal to the distal extremity of the instrument.

In the prevailing models of forceps the blades are fenestrated. This not only conduces to lightness, but more evenly distributes the pressure. The open blades, too, take up less room than the solid. The fenestra is usually from 8 to 13 cm., 3½ to 5 inches, in length, and is wide enough to leave a rim of 1 cm., ⅜ inch, in width. By some authorities solid blades are preferred.

Short, straight forceps, so called, about two-thirds the full length, and having no pelvic curve, is popular with some obstetricians for very low operations. A single long double-curved forceps, however, usually serves well all purposes for the general practitioner.

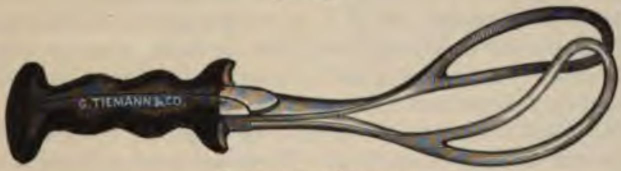
The instrument should be made of the best tempered steel. Some degree of elasticity is desirable, yet there must be rigidity enough to hold the head securely. In order to do this the weight should be so distributed that the shanks are strong and nearly unyielding, and the blades light, especially toward the tips. Yet it is essential that the blades have sufficient thickness to permit rounding off their edges. This is particularly important at the tips and at the margins of the fenestræ. A common fault with forceps is too great sharpness of the edges of the blades, and injuries of the scalp are of frequent occurrence in consequence of this defect.

The instrument should be kept well polished to facilitate its application. Smoothness of surface and freedom from cracks and crevices are conducive to cleanliness, but are not essential to asepsis if heat is employed for sterlizing.

Of the numerous models of forceps, those most used in this country are the Simpson, the Wallace, the Hodge patterns, and the Elliott, a modification of the Edinburgh instrument. In England the forceps of Simpson and of Barnes, in France that of Pajot and of Dubois, and in Germany the Naegele and the Braun forceps are commonly employed.

Function of the Forceps. The essential function of the forceps is traction. It is intended to replace or to supplement the natural expulsive forces.

FIG. 394.



The author's forceps.

Its use as a compressor, a lever, or a rotator is only exceptionally justified.

Much *compression* of the head by forceps is dangerous to the child. This is especially true when the head is seized in an oblique diameter, which is frequently the case as the instrument is usually applied.

Brain injuries, sometimes serious enough to cause the death of the fœtus, are not infrequent results of instrumental delivery. Again, compression by forceps affords little or no mechanical advantage for extraction, since in most seizures the reduction of one elongates the opposite transverse diameter. Moreover, when the forceps is applied in relation with the lateral walls of the pelvis the compression obtains in the direction in which there is usually most pelvic space and in which the reduction is least needed.

It must be remembered, too, that the more rigid the grasp of the head the more the natural mechanism is interfered with.

Moulding of the head is better trusted to the pressure of the pelvic walls, which applies compression only where it is needed, lengthens the head diameters only in the direction of the birth-canal, and inflicts a minimum of injury. The intentional use of the forceps as a compressor must be condemned. The aim should be rather to make the pressure of the blades light enough, if possible, to leave no marks upon the child.

A certain amount of compressive action, however, while undesirable, is unavoidable. It results necessarily from the grasp required to hold the handles, and it increases with the strength of the tractile force. It is evident that the risk of fœtal injury from pressure is diminished by a slow and gradual delivery with the least possible expenditure of force. The compression should not only be gentle, but also be intermitted, as a rule, at frequent intervals. A forceps with short handles, having little compressive power, lessens the danger to the fœtal head.

The *lever* action of forceps is developed by pendulum movements of the handles during traction. This is to some extent a mechanical gain, the resistance being overcome in detail. Less force is required to move down first one side of the head, then the other, than to move both together. This practice, however, is not free from danger to the maternal soft parts, and is seldom to be recommended. That part of the wall of the passages about which as a fulcrum the lever acts is bruised under the pressure of the blade. These remarks refer especially to the lateral movements of the forceps practised by some operators. Swaying the handles in a sagittal direction is even more objectionable, since the passages are more likely to be injured by the edges of the blades than by their broad flat surfaces. Generally a steady pull is best. Direct traction not only imitates the action of the natural powers, but it inflicts the least traumatism, and is all-sufficient for the purpose.

As a *rotator* the forceps, except in trained hands, is a dangerous instrument. Attempts at correcting malpositions with forceps may result in laceration of the passages. This is true even of the straight forceps, and especially so of instruments with the usual pelvic curve.

Faulty positions should, if possible, be reduced by manual interference before the forceps is applied. In delayed rotation it is sometimes permissible to draw the leading pole forward with the fingers. Rarely rotation may be assisted with the forceps. When the head has not been seized primarily in the biparietal diameter, the blades should occasionally be readjusted as the head descends, and care must constantly be taken that the influence of the natural agencies for producing rotation is not resisted. Most essential is a light grasp of the forceps, with the hands near the lock, permitting the greatest possible freedom of head movements. Rightly applied the blades will usually be kept in position by the pressure of the pelvic walls, and a strong hold upon the handles is not required to prevent slipping.

Prerequisites and Contraindications to the Use of Forceps. Before resorting to forceps the obstetrician must satisfy himself that the following conditions are present:

1. The relative size of the head and pelvis must be such as to make the extraction safely possible for mother and child. The election of forceps is not to be based on the pelvic measurements alone. The size and plasticity of the fœtal head must be estimated. Approximate measurements of the head may be made with calipers through the abdominal wall. The presence or absence of disproportion may be determined, too, by noting whether the head has sunk into the excavation or can be made to do so with suprapubic pressure, and, if necessary, by exploration with the hand in the uterus. Well-defined osseous obstruction or much narrowing of the canal from other causes should, as such, preclude the

use of forceps. Its alternatives must be considered when the resistance is too great to be overcome with violent traction.

2. The head must be of nearly normal size and consistence if it is to be securely grasped by the blades. The cephalic curve of the forceps is best adapted to heads of average size. An easily compressible head is equivalent to a small head. An undeveloped, a highly macerated, or a perforated head is not suited to forceps, a firm hold being impossible. In marked hydrocephalus and in excessive development from whatever cause, not only is the resistance too great, but the divergence of the blades is excessive and their grasp insecure.

3. The child must be living and viable, except the extraction is to be an easy one. When the delivery of a dead child by forceps would be at all difficult, perforation should be substituted.

4. The position of the head must be favorable. When possible, malpositions are to be corrected by manual interference. This is not always practicable after the head has sunk deeply into the pelvis. One of the refinements of modern forceps operations is the correction of certain malpositions with that instrument.

5. It is desirable that the head shall have engaged in the brim; in other words, shall have descended far enough to bring the biparietal diameter to the level of the inlet, or that it can be crowded down to that extent by suprapubic pressure. By many authorities forceps is rejected in favor of version before engagement. When the head is free above the brim the proper application of the blades is difficult or impossible. At best the cephalic mass will be caught obliquely by one side of the occiput and the opposite side of the sinciput. In this seizure not only is the pressure of the blades dangerous to the child, but it tends to bring about premature flexion and rotation, and thus to increase the resistance. Yet the widely accepted rule, version before and forceps after engagement, is subject to exceptions. This is especially true since the introduction of the axis-traction instrument. When the waters have drained away and the fœtus is firmly invested by the uterus, version is a difficult and dangerous operation. Forceps in such conditions often serves better the interest of both patients. In general, when the conditions are favorable for an easy forceps extraction, the latter is preferable to a difficult version. No attempt to apply the blades, however, must be made till the head has been pressed down as deeply as possible and so held by an assistant.

6. The cervix must be fully dilated or easily dilatable, otherwise dangerous laceration of the lower uterine segment may result. In emergencies, recourse may be had, if necessary, to manual dilatation, and sometimes multiple shallow incisions of the lower border of the cervix.

7. The membranes must be ruptured and retracted above the head. Should the membranes be caught in the grasp of the blades, the placenta may prematurely be torn partially or wholly from its attachment.

Indications for Forceps. The necessity for forceps delivery may arise from anomalies (1) of the expellent forces, (2) of the passages, (3) of the passenger, or (4) in consequence of some complication of labor independent of the mechanism.[1]

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[1] The indications for forceps will be found more fully treated under Anomalies of the Mechanism of Labor.

1. *Forces at Fault.* Failure of the pains is not of itself alone an indication for forceps. The physician cannot justify himself in applying forceps to save his own time. Inertia uteri in the presence of conditions likely to jeopardize the interests of mother or child may call for instrumental delivery when simpler measures have failed. Here, as elsewhere, forceps is indicated when its dangers are less than those of delay. Important elements in the question are the strength and endurance of the mother as indicated by the force and frequency of the pulse, the presence or absence of exhausting pain, the quality and strength of the fœtal heart tones, and the probable difficulties of the operation. Impending exhaustion on the part of the mother is a frequent occasion for instrumental delivery. Just when forceps is permissible under this indication is often a delicate question requiring the exercise of critical judgment. As a rule, when the head is low down in the passages and has been arrested for a half-hour because of feeble pains, the labor should be terminated with forceps.

2. *Passages at Fault.* Marked osseous obstruction, as already observed, forbids the use of forceps. Yet moderate narrowing does not necessarily debar. The limit of contraction for forceps is variously stated by different authorities as from 8 to 9.5 cm., 3¼ to 3¾ inches. But methods of treatment in deformed pelves cannot be formulated on pelvic measurements alone. The choice of procedure must rest on the relative size of head and pelvis. Pelvic contraction is an indication for forceps only when the plasticity and size of the head permit. The field of forceps is somewhat extended by axis traction and by the Walcher posture. Yet if the child is living and viable, symphyseotomy or Cæsarean section is generally better, in the interests of both patients, than a very difficult forceps delivery.

As against version, in slight contraction, forceps has the advantage that under modern methods the pull is in the pelvic axis, more time is permitted for delivery, and the uterus is less exposed to both septic and mechanical injuries. It is easier to sterilize instruments than hands.

Tentative use of forceps is permissible in moderate obstruction in the soft parts.

3. *Passenger at Fault.* Forms of fœtal dystocia amenable to forceps are met with in occipito-posterior positions, in mento-anterior face cases, and in pelvic presentation with the breech arrested in the excavation. The instrument is superior to other methods in certain difficult extractions of the after-coming head. Evidence of fœtal exhaustion or asphyxia, pulse above 160 or below 100 to the minute, may necessitate immediate instrumental delivery. Forceps is contraindicated in high transverse positions of the face, owing mainly to the danger to the child from pressure of the blades upon the vessels of the neck. The delivery of a posterior-face case is impossible as such, yet attempts at instrumental rotation may sometimes be permissible.

4. *Accidental Complications.* Complications of labor sometimes demanding forceps are hemorrhage, prolapsus funis, rupture of the uterus, eclampsia, and all acute and chronic diseases or other complications of labor in which immediate delivery is required in the interest of mother or child or both.

In general the low operation is frequently justifiable on minor indications, the high operation only on major indications.

Dangers of the Forceps Operation. Accidents to which the mother is exposed and which are not always preventable in forceps delivery are slight contusions and lacerations of the passages. Injuries to the uterus, to the vagina, and especially to the pelvic floor are more frequent than in spontaneous labors. Most liable to tear are the cervix and the vaginal orifice, since the resistance from the soft parts is usually greatest at these points. Serious accidents are, unfortunately, common in careless and violent forceps deliveries. A cervical tear may invade the body of the uterus and enter the peritoneum. Pelvic floor injuries not infrequently destroy the recto-vaginal septum. Owing to faulty application or to unguarded traction, the blades may slip from the head either vertically or horizontally and be dragged abruptly through the passages. Even serious bladder wounds and perforation of the posterior vaginal fornix may occur at the hands of the careless or the inexpert. If the handles are carried too far forward or backward during traction, the vaginal walls may be cut by the tips of the blades. Misdirected traction exposes the maternal soft parts to needless injury, and even rupture of the pelvic joints is possible in violent instrumental delivery. The difficulty of extraction may be increased in the unskilful use of forceps by hindering the normal mechanism.

The danger is obviously greater the higher the head in the pelvis, since the control of the instrument is more difficult and injuries to the upper portion of the passages more serious. The head before it has fully engaged in the brim is imperfectly moulded, the grasp is bad, the normal head movements are impeded, and the difficulty of extraction is increased accordingly.

To the child the risks of forceps delivery are greater than to the mother. Intracranial hemorrhage from injuries to the meningeal or cerebral vessels is not an infrequent result of compression in difficult, and this sometimes occurs in easy, forceps extractions. Injurious pressure may arise from rapidly dragging an unmoulded head through the pelvis as well as directly from too forcible grasp of the blades. A considerable fœtal mortality is attributable to these injuries, and permanent mental and physical infirmities may result in children who survive them. Hemiplegia, idiocy from cerebral atrophy, psychical disorders, and even epilepsy in later life are believed to be possible consequences of these lesions. The region of the lower anterior angle of the parietal bone is the most vulnerable one.

When the cord is coiled about the child's neck it is exposed to pressure from the tips of the forceps blades and fatal asphyxia may ensue. Facial paralysis results most frequently from compression of the facial nerve-trunks, but may occur from the pressure of an intracranial blood-clot. The former injuries are usually unimportant, the paralysis disappearing within a few days. Injuries to the brachial plexus have occurred in forceps operations, but probably from stretching the nerve-trunks rather than from pressure effects. Abrasions, indentations, lacerations, and contusions of the scalp, face, and eyeballs are common in instrumental delivery. Yet anything more than slight or transient markings must be regarded as a reproach upon the skill of the operator. Deep indentations of the skull or fracture of the cranial bones can result only from culpable ignorance or carelessness.

Fatal asphyxia is common after births terminated with forceps. This may result from premature efforts at respiration provoked by peripheral irritation, or from the inhibitory effect of brain compression on the cardiac movements through irritation of the vagus. When head and pelvis are proportionate the skilful and timely use of forceps should, as a rule, diminish rather than increase the fœtal mortality.

Preparation for the Forceps Operation. The bladder and the rectum are to be emptied; either of these viscera if distended may suffer serious injury from the forceps. The cleanliness of the operation may be promoted by thoroughly washing out the lower bowel as a preliminary measure.

The quality and the frequency of the fœtal heart tones should be noted and should be listened for at intervals during delivery. Anæsthesia to the surgical degree is generally advisable, and for this purpose ether, as a rule, is to be preferred. In low operations mere obstetric anæsthesia often suffices, or none at all may be necessary. In all prolonged and difficult extractions complete narcosis is required. The administration of the anæsthetic should, if possible, be entrusted only to a skilful medical assistant, and should be managed in accordance with the usual rules of surgical practice.

The abdomen, the thighs, and especially the external genitals are rendered as nearly aseptic as possible. Particular care is given to the cleansing of the vulva and its immediate surroundings. If the vagina is healthy and has not been exposed to unclean contact during the labor or for some hours before, no internal antisepsis is required. When the vagina or cervix is diseased or there is reason to believe they have been infected, the passages should be prepared with the same care as are the external genitals. They are cleansed with soft soap and hot water, with the aid of general friction, for five minutes, care being taken to prevent abrasions. The friction is best applied with the fingers or with a soft cotton ball held in the grasp of a suitable forceps. A sublimate douche 1 : 4000, or other equally active antiseptic solution, is then to be employed for the same length of time, the friction being continued. The lubrication of the parts may, if necessary, be restored by the plentiful use of sterilized glycerin or vaseline. In hospitals it is a common antiseptic precaution to cover the legs and feet with sterilized leggings or drawers. Wrapping them in aseptic sheets suffices, and this method is recommended in family practice where the leggings are not usually available.

The operator's hands and forearms are to be prepared as for a major surgical operation. A sterilized operating-gown or, in the absence of this, an apron or a sheet should protect the physician's clothing against contact with his hands. The instrument is best sterilized by boiling. It may be wrapped securely in a towel before sterilizing, and so kept till wanted for use. A basin containing a bichloride solution, 1 : 2000, or other suitable antiseptic, and one or two squares of cheese-cloth should be provided. The antiseptic solution serves for rinsing the hands as required and for cleansing the external genitals of the discharges. An ounce or two of glycerin or of vaseline which has been sterilized by heat may be found useful as a lubricant for hands and instrument.

The operation is most conveniently conducted on a firm table which has been properly cleansed, dressed, and covered with a surgically clean sheet. When the patient is delivered on the bed, as is usually the custom in private practice, the mattress is protected with a rubber sheet. The bed-linen and the patient's clothing must be as nearly aseptic as possible. A small foot-tub or infant's bath-tub or slop-jar is placed on the floor at the edge of the bed to receive the discharges. A rug or a table oil-cloth spread under it saves soiling the carpet.

Indispensable to a successful and safe forceps delivery is an exact knowledge of the position of the fœtal head. In case of the slightest doubt or any possibility of error, the diagnosis of position should be confirmed by passing the hand, if necessary, into the uterus. Finding an ear may suffice for determining the fœtal position, but, as a rule, the entire head should be examined. This examination can best be made after the patient has been placed under the anæsthetic. With the aid of anæsthesia and with the hand in the uterus it is possible in every case to know with absolute certainty the position of the head.

The cervix must be fully dilated or so soft and yielding as to permit the passage of the head without risk of tearing. Dilatation may be completed if necessary with the hand or by means of a water-bag, and even multiple incisions to the depth of half an inch are permissible in emergencies requiring prompt delivery.

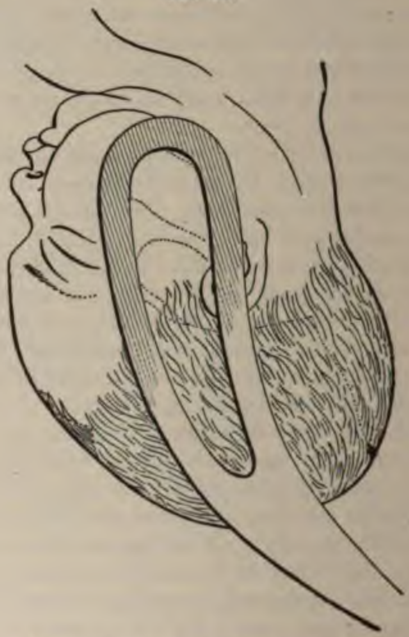
POSTURE OF THE PATIENT. In this country, in France, and in Germany the position generally preferred for ordinary forceps delivery is the partial or complete lithotomy position. The patient is placed on her back across the bed with the thighs and the legs flexed, and the knees held apart, the hips extending over the edge of the bed, or in a similar position on a firm table. One assistant on each side is usually necessary for holding the limbs. In the absence of assistants a Robb or Buckmaster leg-holder or Dickinson's sheet-sling may be utilized for the purpose.

The left lateral position is usually adopted in England for forceps delivery, and is known as the English position.

Walcher's Position. It is well known that the sacrum, especially in in the later months of pregnancy, is capable of a slight nutatory motion on a transverse axis passing through its second vertebra. Walcher, in 1889, called attention to the importance of utilizing the mobility of the sacro-iliac joints in difficult labor. The sacral promontory lies in a plane above the axis of rotation and in front of it. The promontory, therefore, moves forward and backward according to the changing inclination of the pelvis in different postures of the body, and the tip of the sacrum, of course, moves in reverse direction. When the woman lies in the lithotomy position, the thighs being strongly flexed upon the abdomen, the conjugate diameter of the pelvis is shortened; when placed in the dorsal position with the hips close to the edge of the table and the lower extremities hanging, that diameter is lengthened. The latter posture is known as Walcher's position. (See Plate XI.) The gain in the conjugate on changing from the lithotomy to the Walcher position is variously estimated at from 5 to 13 mm. In a series of observations made by the writer the increment was, in the cadaver of the non-puerperal subject, 3 mm., and in the living woman within two weeks after labor, from 5 to 7 mm. The gain, though small, may be utilized to advantage in moderate disproportion between head and pelvis. In difficult extractions the patient should be placed with the thighs in full extension till the largest circumference of the head has passed the brim. On the other hand, the dorsal recumbent posture, thighs moderately flexed and knees held apart, and especially the extreme lithotomy position is best during the extraction of the head through the outlet of the bony pelvis.

The Operation. The operation is spoken of as high, low, or medium, according to the situation of the head in the passages; it is *high* when the head is at the superior strait or barely engaged therein, *low* when it rests on the pelvic floor, and *medium* in intermediate situations. These operations differ in the extent and character of the manipulations involved, not only by reason of the changing direction of the birth-canal, but also because of the varying positions of the fœtal head at different stages of descent. Low forceps delivery is a comparatively simple undertaking; the high operation is one demanding the utmost skill and tact.

FIG. 395.



Cephalic application of forceps over the parietal eminences. (FARABEUF and VARNIER.)

THE APPLICATION of the forceps may be cephalic or pelvic. In the former the head is seized transversely, the blades resting over the parietal eminences (Fig. 395); in the latter the blades are applied in relation with the sides of the pelvis without reference to the head.

Application to the sides of the head has the following advantages: The grasp is symmetrical, the blades fit better, they do less injury to the head, the normal mechanism is less disturbed.

When the blades are applied to the sides of the pelvis the head is usually caught obliquely; in high applications the grasp falls over one frontal bone and the opposite side of the occipital—a direction in which compression is especially harmful and the grasp likely to be insecure.

On the other hand, the pelvic application of forceps is simpler and easier than the cephalic, and in inexperienced hands less endangers the soft parts of the mother; if the handles are held lightly and the traction is intermittent, the pressure on the head is usually well borne.

In low operations, rotation being complete or nearly so, application to the sides of the pelvis brings the blades at the same time in relation with the sides of the head. It is only in high or medium cases that the choice of methods must be considered. In high operations the difficulty and danger of the cephalic application are, as a rule, too great to justify the inexperienced operator in attempting it. On the whole, the beginner will do well to content himself, as the vast majority of physicians in general practice do, with the pelvic application of forceps. The expert will best serve the interests of both patients by electing the cephalic. When, however, it becomes necessary to bring the head down through the brim, the blades are to be adjusted first in a transverse diameter of the pelvis; after the head has entered the excavation the instrument may be readjusted or removed and reapplied over the parietal bones.

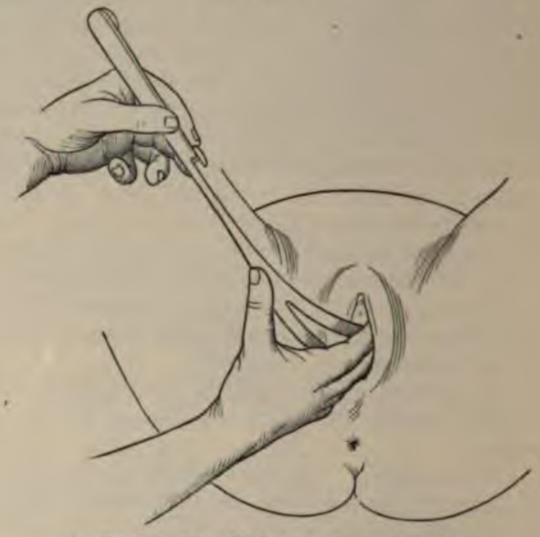
STEPS OF THE OPERATION. The operation comprises four steps: The introduction of the first blade; the introduction of the second blade; locking the forceps; the extraction of the fœtus.

Application with reference to the pelvis, the method most commonly pursued, will first be considered. It will be assumed that the head is in an anterior position.

1. PELVIC APPLICATION. (*a*) *Introduction of the First Blade.* If hands and instrument are wet with the antiseptic solution no other lubricant, as a rule, is required; should any be needed vaseline or glycerin previously sterilized by heat may be used. The latter is the more cleanly.

For convenience in locking, the left, since it is the lower arm of the forceps, is usually passed first. The operator sits or stands as may be most convenient. The patient in position and all preparations complete, he introduces two or more fingers of the right hand into the vagina with their volar surfaces facing his left. They are pushed upward and backward between the head and the left wall of the passages. If the head is still in the uterus care will be required to make sure that the fingers are passed within the cervix. The finger tips are carried as far as they will go readily, and the cervix is held well outward away from the head. The nearer the head to the vulvar orifice the greater the difficulty and the less the need of pushing the guiding fingers deeply in the pelvis. The left branch of the forceps is now taken in the left hand and the blade is introduced, the palmar surface of the hand in the passages serving as a guide. The arm of the forceps is at first grasped near the lock and is held lightly between the thumb and finger and in a nearly vertical direction (Fig. 396). If a firmer grasp is required as the blade passes alongside the head the handle may be held in the full hand. The instrument is pushed gently on in the direction of the passage till it reaches the head. From this point the course of the blade is that of a spiral; it must follow both the pelvic and the cranial curves. After it has passed beyond the reach of the fingers it is guided by hugging the head with the tip. Urged cautiously along, it finds its own way, moving in the direction of least resistance. No force is necessary or permissible. Should any obstacle be met it must not be overcome by increasing the pressure; the blade should be partially withdrawn and its direction slightly altered till it slips easily into place. It is carried well up till the tip barely overreaches the head. Should a uterine contraction occur, the manipulations should be suspended till it ceases. Usually under anæsthesia the pains are in abeyance.

FIG. 396.



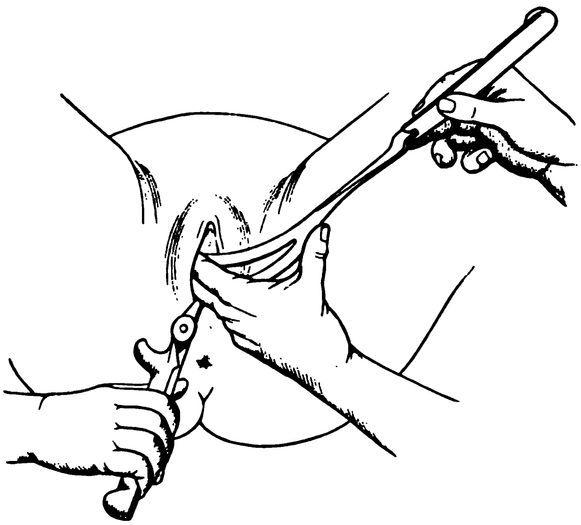
Application of first blade of forceps. (ZWEIFEL.)

(*b*) *Introduction of the Second Blade.* The right half of the forceps is held in the right hand and the blade passed on the left hand as a guide, in a manner entirely similar to that already described for the first blade. The handle of the first arm may, meantime, be held by an assistant, or be left to itself (Fig. 397). The application of the second blade, while not so easy as the first, is not, as a rule, difficult.

(*c*) *Adjustment and Locking.* The operator now seizes one handle in each hand, the thumbs being extended along the upper surface. If the blades are properly applied the two halves of the instrument will fall into symmetrical positions and will lock easily. If the handles do not face each other, push them well back against the perineum; should one be higher in the pelvis than the other, push the lower one gently up. In high operations it will always be necessary to press the handles as far back as the perineum will permit. The locking must never be forced. If difficulty is still encountered, the blades should be removed or partially withdrawn and repassed. With a good seizure, the head being of normal size, the handles, while they are not in contact, will not be far apart. A common mistake in the application of forceps consists in failing to pass the blades far enough. The aim should be to bring the head well within the cranial curvature of the instrument. Care must be taken that the grasp is not too far forward or backward with relation to the pelvic axis, and that it does not include a loop of the cord. As the arms are locked a finger is swept around the shanks to prevent catching the labia or vulvar hairs between them.

2. CEPHALIC APPLICATION. It is assumed that the head has passed the brim or is in the excavation. The left blade usually is passed first. The guiding fingers are carried up along the side of the head as far as they can reach, finding the place where there is most room. The blade is then introduced, and, with the aid of one finger hooked under the front or the back rim of the fenestra, it is then urged gently sidewise into position over the parietal eminence. With changed hands the remaining blade is applied in like manner over the opposite parietal bone. The internal fingers, pushed up as far as possible between the side of the head and the sacro-iliac ligament, guide the blade to its destination. Should it have been necessary to pass the right blade first, the handles must be readjusted for locking.

FIG. 397.



Application of second blade. (ZWEIFEL.)

If the forceps is in proper relation to the head it will lock readily. It will now be seen that the handles do not lie in the median plane, as they do when applied in relation with the sides of the pelvis. In high applications they will be found nearly or quite in line with the oblique diameter of the pelvic brim, facing strongly to one side. When the head is deeper in the pelvis they look more nearly forward.

(*d*) *Extraction.* The forceps being locked, the operator examines to assure himself finally that the blades are in proper relation with the head. The force and frequency of the fœtal heart are noted and are listened for at intervals during delivery.

In easy extractions the pull is applied with one hand while a finger of the other is held against the head to give warning should the instrument slip. When more force is required both hands are used for traction, and examinations are made in the intervals.

(*a*) *In Low Operations.* In low operations the delivery is effected for the most part or wholly under ocular inspection. With the head well down on the pelvic floor and in anterior position but little tractile force is needed, and the risks of either fœtal or maternal injuries are insignificant. The forceps is grasped with one hand near the lock, the first and second fingers hooking over the projecting shoulders at the upper ends of the handles. The least possible compression is thus exerted upon the head. In many cases none is required to maintain the grasp. The walls of the birth-canal, as a rule, make sufficient pressure to keep the blades in place when the seizure is good and little tractile force is employed. The palm of the hand may be turned up or down.

The tractions, like the natural pains, should be intermittent. They should continue for about one minute, and the intervals may be one or two minutes. During the intervals the forceps is unlocked to relieve the head from pressure. The line of traction must be such that the blades are kept constantly in the axis of the birth-canal.

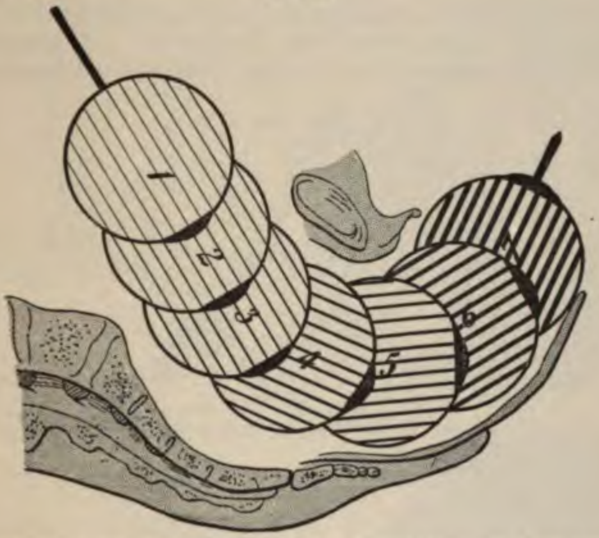
The extraction of the head may or may not be completed with the forceps. The thickness of the blades is too small to make any appreciable difference in the distention of the pelvic floor, yet too great strain may be brought upon the resisting soft parts by misdirection of the tractile force or by disturbance of the normal mechanism of expulsion even at the hands of an expert. Injury may inadvertently be done by dragging the head too heavily against the pelvic floor or by too rapid extension. The writer prefers, therefore, to remove the forceps, as a rule, when the head has descended so far that it no longer recedes in the intervals between tractions. The head is then expelled easily by light pressure applied from behind through the perineum. With the fingers of one hand upon the occiput and with the other hand laid flat upon the bulging surface well back of the posterior vulvar commissure, thumb to one side and fingers to the other of the genital fissure, the advance of the head is perfectly under control. On no account are the fingers to be introduced into the rectum for the purpose of shelling out the head. The practice is unnecessary and is incompatible with a strict asepsis.

The forceps blades are removed in the reverse order of their application. Two fingers of one hand are applied over the anterior edge of the blade just within the vulva to protect the maternal soft parts. As the blade is withdrawn the handle is gradually swept well up over the opposite groin. Should an obstacle be encountered the blade must not be forcibly extracted. If the obstruction cannot be overcome by slightly changing the direction of the blade, the latter may be left in place till the head is delivered.

If delivery is completed with forceps the natural mechanism of expulsion must be closely followed. The head is drawn down till the nucha is well under the pubic arch. Then by an upward movement of the handles the forehead, the face, and the chin are made to sweep in succession over the vulvar edge. (Fig. 398.)

The handles may be held forward during the perineal stage of the operation as far as possible without bruising the soft parts between the anterior edges of the blades and the ischio-pubic rami. This will necessitate carrying the handles more and more forward and upward as the head descends, till at the moment when it escapes they are almost in contact with the mother's abdomen. After the pelvic floor begins to bulge the instrument is held by the shanks near the lock with the radial edge of the hand up.

FIG. 398.



Showing the normal course of the head in its descent through the birth-canal. (FARABEUF and VARNIER.)

If in doubt as to the extent to which the handles should be swept forward, let go the handles and observe their position. If the blades are in proper relation to the head, the direction which the handles assume when left to themselves will be that in which they should be held during the next traction.

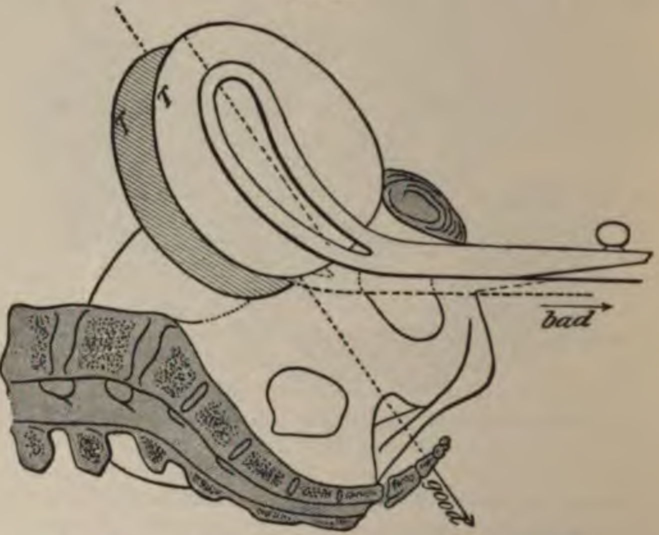
During the perineal stage of the operation the head should be pressed well up into the pubic arch. The perineum and anal orifice are covered with a sterile towel. Over this the hand is held broadly across the bulging pelvic floor, the thumb lying along one side and the fingers along the other side of the vulva. Firm pressure is made toward the pubic arch during traction. This manipulation aids materially in preventing pelvic-floor injuries by relieving the fascial structures of the floor of excessive strain during extraction of the head.

In artificial as in spontaneous births time is an important element in the prevention of perineal injuries. The extraction must be slow and gradual to permit the pelvic floor to stretch. In primiparæ, as a rule, a half hour will be required for this stage of the delivery, and little less in most other cases.

(*b*) *In High Operations.* As a general, if not an invariable, rule, axis-traction forceps should be substituted for the classical instrument at the superior strait. If the ordinary forceps is used both hands are usually required for traction. If a straight pull upon the handles is to be employed they may face each other with the handles flatwise between them. The first two fingers of one hand are hooked over the transverse projections and upon these fingers rest the corresponding ones of the other hand. The remaining fingers of one hand encircle the handles, holding them firmly enough only to prevent the blades from slipping. When the instrument is rightly applied little or no compression is necessary.

But to act to the best advantage the tractile force must be applied as nearly as possible in the axis of the birth-canal. A straight pull on the handles wastes a part of the force by dragging the head against the anterior pelvic wall (Fig. 399), and the misdirected force is not only lost, but is mischievous. It increases the resistance and adds to the risk of both maternal and fœtal injuries. Yet with an instrument of moderate pelvic curve the disadvantage of direct traction on the handles is insignificant in easy forceps deliveries.

FIG. 399.

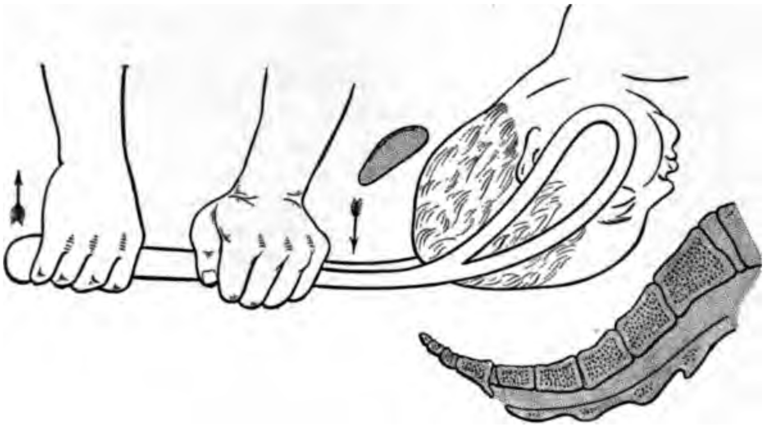


Head at superior strait; right and wrong traction. (FARABEUF.)

Axis traction is possible with the common forceps by Pajot's (Galabin's) manœuvre, which is executed as follows: The handles are held lightly with one hand near the lock, to avoid much compression, and the other hand is applied upon the shanks near the vulva. Pressing downward with the hand on the shanks while the other pulls upward at the handles, the two forces may be so balanced that the resultant shall act in the line of descent. If the operator stands by the bed or table, the hands are applied above the instrument with the palmar surfaces down (Fig. 400); sitting the hands grasp the forceps palms upward (Fig. 401). The mechanical principle involved is also set forth in Fig. 402.

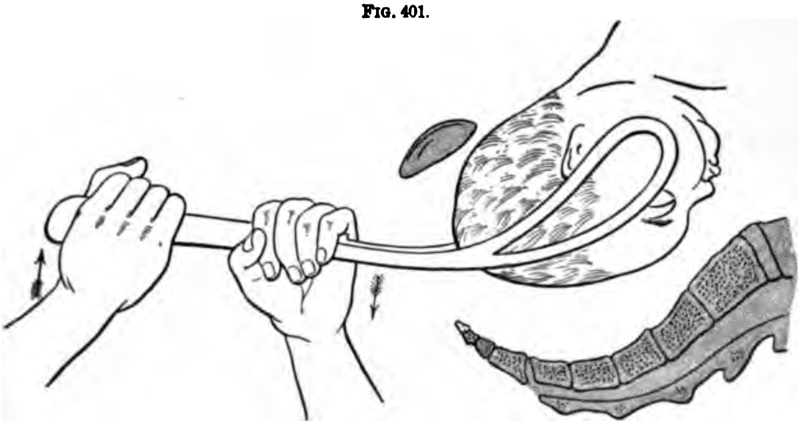
Line of Pull. A straight line passing through the umbilicus and the tip of the coccyx is practically the line of pull till the head reaches the pelvic floor; this line is parallel with the posterior surface of the symphysis pubis, which may be taken as the guide. For greater accuracy the direction may sweep very slightly backward in conformity with the curvature of the sacrum. In all high operations, and especially in pelvic distortion, where we have no reliable anatomical guides to the axis of the bony canal, the axis-traction instrument, which itself points out the way and at the same time permits the greatest possible freedom of head movements, offers an obvious advantage.

FIG. 400.



Axis traction with plain forceps, operator standing. Pajot's manœuvre.

FIG. 401.



Axis traction with plain forceps, operator sitting. Pajot's manœuvre.

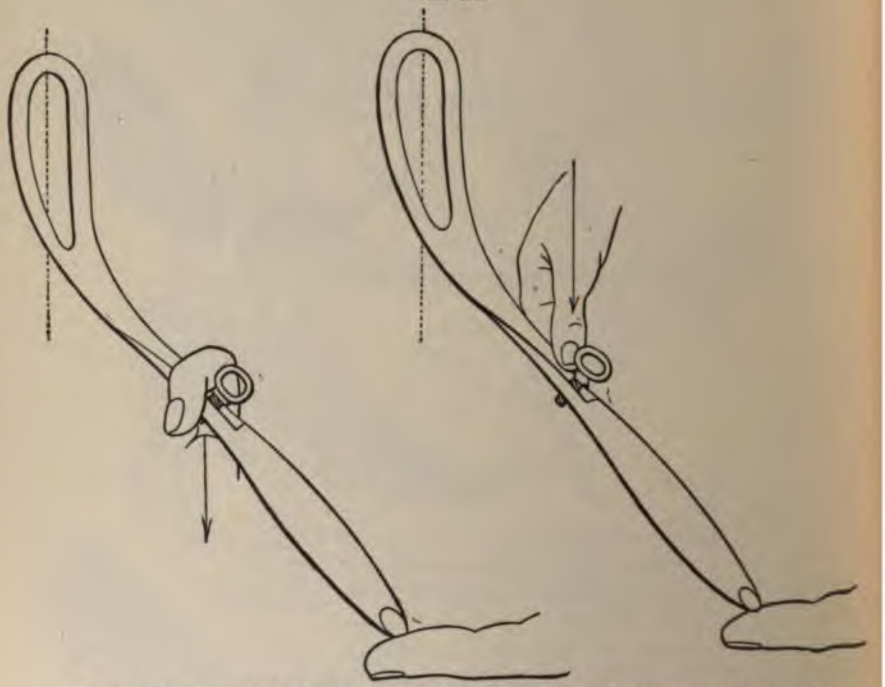
As soon as the pelvic floor begins to bulge under pressure of the advancing head the line of direction turns somewhat abruptly forward. From this point the technique does not differ from that of the low operation already described.

The amount of tractile force should not exceed eighty pounds; in the Pajot method it can scarcely reach that limit at the hands of most operators. In the writer's experience the strength of pull as measurered by a dynamometer attached to an axis-traction instrument, has not in the most difficult of justifiable forceps deliveries exceeded seventy pounds. In a properly conducted forceps operation the force employed will seldom be more than twenty-five or thirty pounds, and it will very rarely amount to fifty pounds.

Traction should be made with the arms only. Bracing the feet and pulling with the weight of the body is neither necessary nor permissible. The beginning traction should be tentative to make sure that the head is properly in the grasp of the blades and that no unusual obstacle or difficulty is present.

Since the high operation must be conducted under full anæsthesia, no aid is to be expected from the natural pains. Well-directed abdominal pressure, however, at the hands of a skilled assistant is an efficient help. This may be continued with advantage till the head is well down on the pelvic floor.

FIG. 402.



Showing the mechanics of axis traction with plain forceps. (FARABEUF and VARNIER.)

The rule of a pull and a pause, of about one minute each, should be observed, and the forceps be unlocked in the intervals between tractions to relax the pressure upon the head.

General Rules. The normal mechanism of labor must be strictly observed throughout the descent. As soon as the equator of the head has passed the brim rotation begins. While the forward movement of the occiput must not be forced it may be favored. When the blades have been applied in relation with the sides of the pelvis, they must be readjusted as the head rotates in course of its descent.

While the head is passing the superior strait the possible advantage of the Walcher position should be borne in mind. Traction should be moderate, permitting time for moulding of the head. As already stated, the cervix, as a rule, should be fully dilated, manually if need be, before the application of forceps. The tension of the cervical ring must be watched during traction, and time must be allowed for it to yield gradually should dilatation prove not to have been complete. If the cervix is drawn down to the vulva it may be pushed back over the head gently with the fingers of one hand, while moderate traction upon the handles of the instrument is applied with the other.

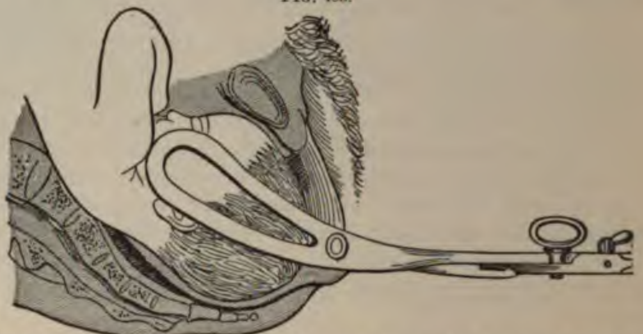
(*c*) *In Medium Operations.* The method of procedure in cases intermediate between the high and the low operation scarcely needs discussion. It should be remembered that in the typical relation of head to pelvis the sagittal suture approximates the antero-posterior diameter of the pelvis only when the head has reached the outlet of the soft parts. In the latter situation the blades applied with reference to the pelvis fall directly over the biparietal diameter. The higher in the pelvis the more oblique will be the seizure of the head in the pelvic application of the instrument.

Forceps in Occipito-posterior Positions. In posterior positions of the vertex before engagement forceps is inadmissible. It is the writer's practice, if the head is movable at the brim or can readily be pushed up, to rotate not the head alone but the entire fœtus into dorso-anterior position. Before rupture of the membranes this is frequently possible by external manipulation. If the waters have escaped one hand is carried into the uterus to the posterior shoulder, which is swept outward away from the median line, the anterior shoulder at the same time being urged inward toward the median line by the external hand over the abdomen. This is done with the aid of full anæsthesia. After bringing the occiput to the front the head is crowded into the pelvic brim by external pressure, and the forceps then applied, if necessary.

If the head has engaged too firmly to permit correction of the malposition, forceps should be withheld as long as possible. In general, rotation may be awaited safely so long as the pains are good, the pelvic floor resilient, and the conditions of both patients such as to justify delay. Except in extreme emergencies, simple measures should be exhausted before resorting to instrumental delivery. The operation is more difficult and is much more dangerous to mother and child than when the occiput confronts the anterior half of the pelvis, and must not be lightly undertaken. When forceps must be used, application to the sides of the head is desirable, yet it is more difficult than in anterior positions. The cephalic application, however, is inadvisable before the head has descended into the cavity. Generally, it will be found best to introduce the anterior blade first, whether that be the left or the right one. A moderately firm grasp will be required to prevent slipping (Fig. 403).

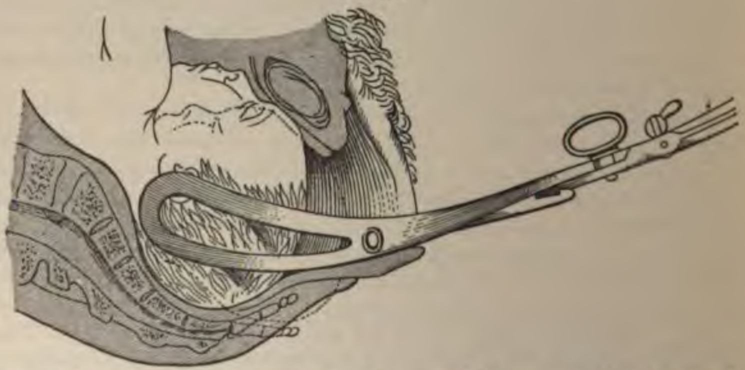
In occipito-posterior positions the arrest of the head frequently means imperfect flexion. To bring down the occiput, when flexion is incomplete, the line of traction should be somewhat in front of the pelvic axis till the forehead clears the pubic arch (Fig. 404). The occipital pole may then be lifted over the vulvar edge with the forceps. The writer, however, prefers to remove the forceps when the head has reached the vulvar outlet and to complete the delivery by manual measures. In most cases it is possible after the head is well in the grasp of the vulvo-vaginal ring to rotate the occiput to the front by manual interference. Under backward pressure with the fingers of one hand against the anterior temple, rotation usually takes place with the utmost facility. The posterior pole of the head may at the same time be drawn forward with the other hand, if necessary. Even should the rotation be difficult there is little risk of doing harm to either mother or child by properly directed manual efforts. It is commonly stated that the fœtal head cannot be turned for more than a quarter circle without danger of injury to the atlo-axial articulation. But Tarnier has called attention to the fact that the torsion is distributed along the entire upper portion of the spinal column, and may safely be carried, therefore, beyond a quarter circle. Exaggerated rotation, he thinks, is less dangerous than the excessive flexion necessary to delivery in the posterior position of the occiput.

FIG. 403.



Relation of forceps to head in occipito-posterior position, head well flexed. (FARABEUF and VARNIER.)

FIG. 404.



Occipito-posterior position, flexion incomplete. Forceps applied over mastoid and pulling forward to increase flexion. (FARABEUF and VARNIER.)

When manual measures fail the cautious use of forceps in skilled hands may serve a useful purpose for rotating the head after it has reached the pelvic floor. It is essential in such use of the instrument that the long axis of the blades be kept in the axis of the birth-canal. To this end, if the forceps has a pelvic curve, the handles must be carried well over toward that thigh which confronts the concavity of the instrument. The rotation is made through not more than ninety degrees at one effort. Time is then allowed for the trunk to rotate with the aid needed of external manipulation. Rotation having been effected, the forceps is removed and reapplied with the concavity of the blades to the front. As a rotator straight forceps is safer than one with the usual pelvic curve.

Should rotation fail, the delivery is completed with forceps, in accordance with the usual mechanism of persistent occipito-posterior positions. The occiput is drawn well forward and lifted over the posterior vulvar commissure. The head is then delivered by a movement of extension about the nucha as a pivotal point.

Forceps in Face Presentation. In mento-posterior face cases forceps is contraindicated. In an impacted face position symphyseotomy should be considered if the child is living and viable, otherwise the head should be perforated.

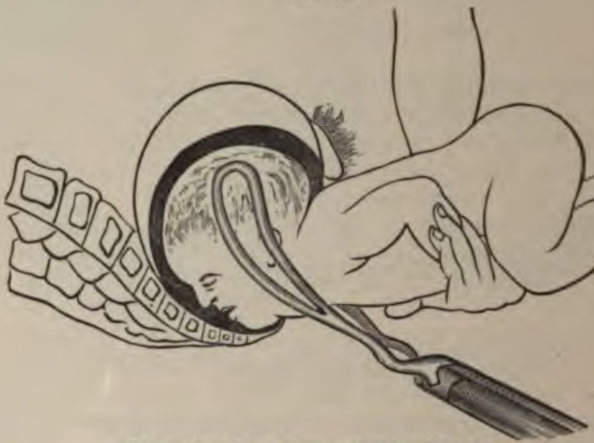
In low mento-anterior face positions forceps delivery presents no special difficulty. Judicious attempts at manual rotation are often successful. Cautious rotation with straight forceps may be tried when other methods fail. Extension must be maintained and the mechanism of natural delivery be carefully followed. The only safe application is to the sides of the head, and care is necessary to secure a firm hold, reaching well back to prevent slipping. Any other seizure endangers the child by pressure upon the neck, and, moreover, is insecure. Traction is made horizontally till the chin is brought well under the pubic arch; then by raising the handles the face, the vertex, and the occiput are successively swept over the perineum.

Forceps to Breech. Forceps, while not well adapted to the breech, is a valuable measure in certain cases of this presentation. When the pelvic end of the fœtal ovoid has so far engaged that a foot cannot be brought down, yet has not sunk deeply enough in the excavation to permit the successful use of finger or fillet, the forceps may be tried. The axis-traction instrument is to be preferred, especially in high operations. The best application is that of Ollivier: one blade resting over the sacrum and one ilium, the other over the posterior surface of the opposite thigh.

Manual rotation is sometimes possible when the position is not primarily suitable for a satisfactory seizure. When the breech is fixed transversely in the pelvis, the blades may be placed over the trochanters. Application over the iliac crests is recommended by some writers, but these bony prominences are compressible, and the tips of the blades are liable to injure the abdomen. In all applications to the breech it is difficult so to regulate the grasp as to make the hold secure and at the same time to prevent injurious pressure. The amount of tractile force should be kept at a minimum by pulling only during the pains and by the help of abdominal pressure applied by an assistant over the fundus. If the child is dead a firm grasp is permissible.

Forceps to After-coming Head. In all cases of breech extraction the forceps should be in readiness for instant use in cases of difficulty in extracting the after-coming head. The forceps in head-last births, while seldom necessary, is the most effective of all methods of delivering the head. The application is attended with no difficulty. The body of the child should be held up over the abdomen of the mother and the blades passed beneath the fœtal trunk (Fig. 405).

FIG. 405.



Extraction of the after-coming head with forceps.

Head Separated from the Trunk. It may become necessary to extract the detached head from the uterus after decapitation or when the head has been torn from the trunk and left behind through unskilful traction upon the trunk in breech births. Frequently, with the aid of suprapubic pressure, the delivery is possible without resort to instruments. In forceps as in manual extraction, the chin in such cases should first be brought down and so held during the delivery, to keep the long diameter of the head in the axis of the uterus.

AXIS-TRACTION FORCEPS.

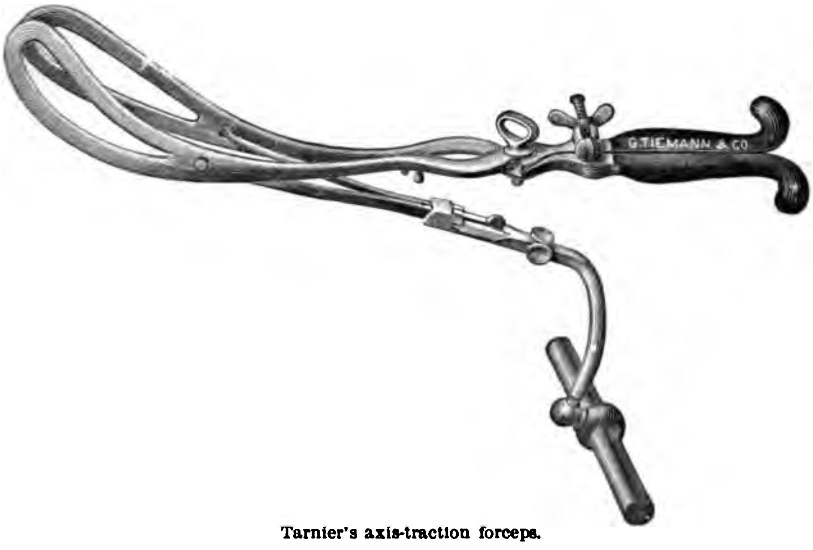
An obvious disadvantage of the classical forceps is the fact that in pulling in line with the handles the tractile force is not applied in the parturient axis. The head as it is drawn down is dragged against the anterior soft parts of the birth-canal (Fig. 399).

By Pajot's manœuvre this fault in the ordinary forceps is obviated in part but not wholly, since it is impossible to estimate precisely the direction of the pelvic axis. Several devices have been proposed with a view to accomplishing axis traction. Among these may be mentioned the forceps of Galabin, with the handles bent backward, Hubert's forceps, in which the traction is made at the end of a rigid arm projecting backward at a right angle from the shanks, and Poullet's forceps, in which the pull is applied by means of tapes passed through apertures in the blades. All these instruments are open to the objection that the line of pull is left to the judgment of the operator, and they do not, therefore, insure precision in the right line of traction.

Another and perhaps a more serious defect in the common forceps is the fact that its rigid grasp interferes to a greater or less extent with the natural movements of the head. In this particular, as in the line of pull, it is in high operations that the ordinary instrument is at its greatest disadvantage. This fault, like the first, loses much of its importance at the hands of a skilful operator, yet is by no means wholly obviated even by the most expert management. After the head has reached the pelvic floor the mechanism is less complex and its regulation more easily at command of the operator.

In 1877 Tarnier, of Paris, gave to the profession an axis-traction forceps which, as since modified, has been widely adopted. In this instrument each arm, which does not differ essentially from the ordinary pattern, is provided with a slender traction-rod which is attached by a movable joint to the heel of the blade and terminates below near the lock. Theoretically the rods should pull from the centres of the blades, since traction from these points would involve no directive action on the head. But to place the traction studs at the centre of the blade it would be necessary to insert in the fenestra a transverse bar, which would be likely to injure the head. The stud is, therefore, located at the heel of the blade. This construction, while not theoretically perfect, practically answers all requirements. The rod runs along the under edge of the shank, and when not in use is held in place by a pin against which it rests at its lower end. After the blades are applied and the instrument locked the necessary compression is maintained by means of a fixation screw attached to the handles. The use of the fixation screw, however, is not always necessary. The lower ends of the traction rods are released from the shanks and are locked to a traction handle. The latter consists of a single rod bent strongly backward and armed at its lower end with a cross-bar for convenience in pulling. The construction of the instru-

FIG. 406.

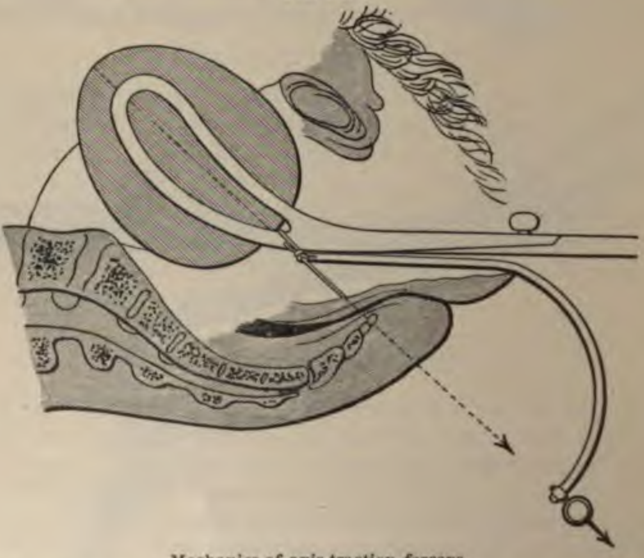


Tarnier's axis-traction forceps.

ment is such that when the traction rods are held about two-fifths of an inch away from the forceps shanks the line of pull will be in the axis of the blades, and, therefore, in that of the birth-canal. A movable joint at the cross-bar and the one at the attachment to the blades permit the utmost freedom of head movements. The blades when properly applied maintain their normal relation to the axis of the passages as the head descends. The application handles change their direction with the changing direction of the blades in the course of the descent, and thus serve as an index of the right line of traction.

Lusk's axis-traction forceps differs from the Tarnier model mainly in being lighter. In the Simpson pattern the traction apparatus is attached to the ordinary Simpson forceps. Murray has made a special study of the principle of axis traction from a mathematical stand-point, and has enunciated a formula for the construction of the instrument. Reynolds and others have devised traction rods to be attached to ordinary forceps; but these appliances only approximately accomplish their object. The axis-traction forceps of the writer is constructed on the formula of Milne Murray, but is much lighter (Fig. 408). A model used for several years weighs, without traction rods and handle, only sixteen ounces, yet has proved equal to all requirements.

FIG. 407.

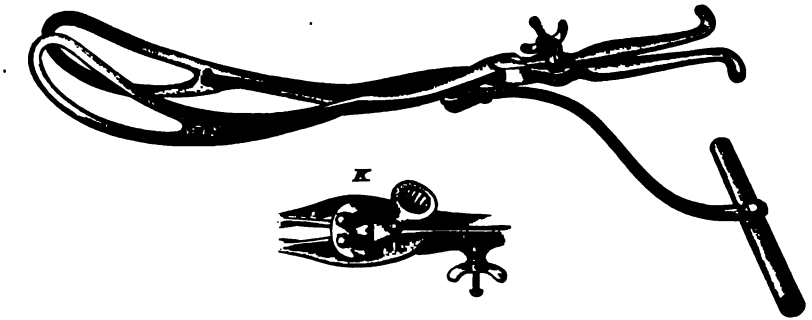


Mechanics of axis-traction forceps.

Pulling at the traction-handle in the direction indicated by the lower arrow, the line of traction is in the axis of the blades, as shown by the upper arrow. (FARABEUF and VARNIER.)

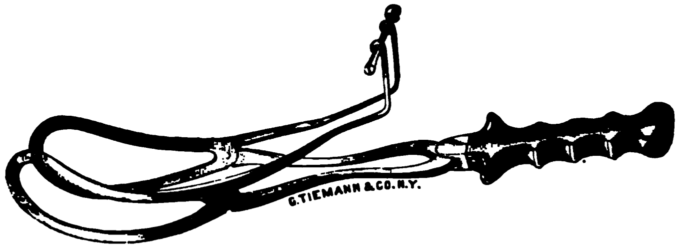
The superiority of axis-traction forceps over the simple instrument, as commonly accepted, depends upon two things: 1. Pulling as it does directly in the line of descent all the tractile force is utilized. 2. The blades being free to follow the natural movements of the head, the normal mechanism is not disturbed. Delivery is thus accomplished with the least possible amount of traction and with a minimum of maternal and fœtal injuries. The facility with which the head may be brought down with axis-traction forceps is often in striking contrast with the difficulty frequently encountered in delivery with the classical instrument. Breus, however, denies that the value of the Tarnier forceps depends in any degree on the axis-traction feature, and attributes it solely to the movable joints of the traction rods and the consequent freedom of the head movements. His own instrument consists essentially of a simple forceps modified by the introduction of a movable joint between the blades and the shanks. A pair of rods rigidly attached to the blades and projecting in front of the shanks serves to indicate the position of the blades (Fig. 409).

FIG. 408.



Jewett's axis-traction forceps.
K. Lock for attaching traction-handle to rods.

FIG. 409.



Breus' Forceps.

Murray and Naegele claim the same advantage for axis-traction apparatus in low as in high operations. In the writer's experience, pelvic-floor injuries have occurred more frequently when the delivery was completed with Tarnier's than with the common forceps. The axis-traction instrument offers no advantage after the head has passed the inferior strait. Below this point the special tractors may best be disused and the delivery be managed as with simple forceps, or the latter be substituted.

Operation. The blades are best applied with the patient in the usual dorsal recumbent position. For extraction she may lie on the back if the operation is conducted on a table; on a low bed she should be turned upon the left side. Walcher's position may be utilized in difficult extractions. After the forceps has been adjusted and locked, the application handles are grasped with one hand firmly enough barely to bring the blades in contact with the head. The fixation screw is then set to maintain the pressure thus obtained, but must not be used for compression, owing to the difficulty of correctly estimating the amount of force applied. The use of the screw, however, is not always necessary. When employed it should be released in the intervals between tractions.

The pull is applied at the traction bar with one hand, while a finger of the other is held against the head to give warning should the blades begin to slip. Very rarely will it be necessary to use both hands for pulling. The traction rods must not be allowed to rest against the shanks of the forceps, but should constantly be held in a position just free from them. As the head descends the application handles move forward, and thus indicate the changing direction in which traction is to be made.

When the head has been brought down to the pelvic floor the traction handle is detached and the delivery completed as with the ordinary forceps, or the classical instrument may be used if preferred.

CHAPTER XXXII.

VERSION.

VERSION may be defined as a manual operation by which the long axis of the fœtal ovoid is wholly or partially inverted. Thus a cephalic may be substituted for a podalic presentation, or a podalic for a cephalic, or a transverse may be reduced to a longitudinal presentation. When the head is made to present, the operation is termed *cephalic* version; when the fœtus is so turned as to bring one or both feet into the birth-canal, it is called *podalic* version. The terms podalic and pelvic version are used interchangeably.

Version may be accomplished in one of three ways: by external, internal, or combined external and internal manipulation.

Indications for Cephalic Version. The indications for cephalic version are limited, since other than a head presentation is commonly due to some disproportion between the head and the pelvic inlet (Pinard).

Transverse and breech presentations when seen before labor or during the first stage prior to rupture of the membranes justify an attempt at cephalic version. To be successful, the membranes must not have been broken, and the pelvis must be sufficiently ample to receive and permit the engagement of the cephalic pole.

Indications for Podalic Version in Transverse Presentation. In normal pelves with the head presenting and the life of the mother or child threatened, if the head is not or can not be engaged, or the cervix is not sufficiently dilated to permit the use of forceps, podalic version is the operation of election. In certain cases of placenta prævia one or both feet may be brought down to control hemorrhage. In prolapse of the cord, when the membranes are ruptured and the head has not entered the brim, attempts at reposition having failed, version may be done. In prolapse of one or both arms, or of an arm and a foot, podalic version is indicated. In head presentations when owing to malposition or other complication the head fails to engage at the superior strait, as in face or brow presentation, twins or irreducible occipito-posterior positions or when proper flexion to secure engagement cannot be made; in anencephalus and in the minor degrees of hydrocephalus; in emergencies complicated with an unengaged head or an incompletely dilated cervix, as eclampsia, accidental hemorrhage, rupture of the uterus, embolism, and death of the mother, podalic version affords the most rapid means of delivery.

Podalic version is indicated in simple flattened pelvis when the conjugata vera is not less than 8 cm. (3.15 inches), the head being of typical normal size; and in all cases of equivalent disproportion between head and pelvis.

Contraindications to Podalic Version are: impaction or firm engagement of the presenting part; tetanic contraction of the uterus with a well-developed ring of Bandl, appreciable two or more inches above the symphysis (Winckel); true conjugate below 8 cm. (3⅛ inches); oblique contraction in which the inlet is encroached upon; long-continued dry labor; cervix not dilated or dilatable. While the last two conditions do not positively prohibit the performance of version, the difficulties and dangers of the operation are so increased that the procedure is hardly justifiable.

Conditions Favorable to the Successful Performance of Version are: exact diagnosis; ample pelvic capacity, with approximate knowledge of the relative size of the child and pelvis; thin and flexible abdominal walls; and the presence of the whole or part of the amniotic fluid.

Dangers of Version. *To the Mother.* In external and bipolar version the dangers are insignificant. In internal version the woman is subject to the increased risks of possible uterine rupture, sepsis, hemorrhage, shock, and extensive lacerations of the cervix and pelvic floor.

The *Child* is exposed by the internal podalic method to injury or death from fractures of the humerus and femur, compression of the spine, and asphyxia during its passage through the birth-canal.

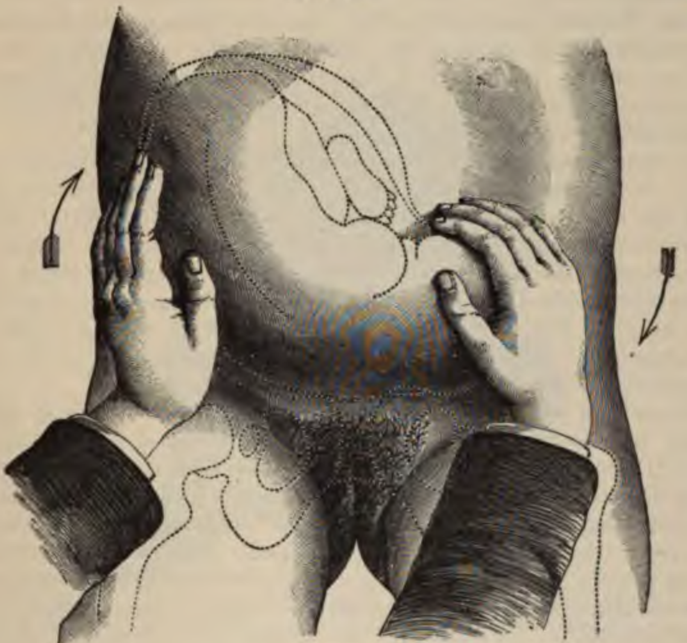
While under modern methods of diagnosis the field of version has been narrowed for the expert by traction forceps, symphyseotomy, and elective Cæsarean section, it will always remain a valuable procedure for the general practitioner in emergencies necessitating rapid delivery in the presence of an unengaged head, and when proper assistance and appliances for the performance of its alternatives are not at his immediate command.

External Version. Version by external manipulation is employed to convert a breech into a head presentation or to correct transverse presentation. It is the simplest and safest method of turning, and is too seldom practised, since few physicians become skilled in abdominal palpation. A positive diagnosis is essential before version is attempted by any method. Pelvic or podalic version by external manipulation is not always practicable. Cephalic version by the external method is frequently possible, and has been advocated in breech presentations by recent writers when seen before or at the beginning of labor. The presence of the liquor amnii, thin, lax abdominal walls, and an ample pelvis are prerequisites. The method is free from all danger of septic infection. Objections which have been urged against the conversion of breech presentations into head cases are: First. In primiparæ it is generally impossible without anæsthesia to perform fœtal evolution, because of the resistance of the maternal soft parts. Second. Fœtal accommodation will commonly cause the breech to return to the superior strait, owing to the continued existence of one of the four general causes of malpresentation and malposition, *i. e.*, small pelvis, large head, excessive liquor amnii, or small child. In multiparæ little is to be gained by the substitution of the head for the breech, as these cases usually terminate favorably, if properly managed, to both mother and child. On the other hand, substitution of the breech for the head by external version may be advantageous in oblique contraction of the pelvis when the antero-posterior diameter exceeds 3¾ (9.51 cm.) inches, since it enables the operator to direct the large occipital pole of the head toward the most roomy side of the pelvis; in transverse presentations; in slightly flattened pelves; and in abnormal presentation of the placenta.

CONTRAINDICATIONS TO EXTERNAL VERSION. This operation cannot be effected when the presenting part has sunk deep in the pelvis, or when the amniotic fluid is scant or has already drained away, when the waters are excessive, or in the presence of a macerated fœtus or twin pregnancy. It is seldom practicable after the onset of labor.

TECHNIQUE. *Preliminary Measures.* The position and size of the child are determined by abdominal palpation. The size of the pelvis is estimated. The bladder and the rectum are emptied. Irregular or spasmodic contractions of the uterus are controlled with an opium suppository, if labor has already begun. The woman is placed in the dorsal position, with the head and shoulders elevated, the legs and thighs slightly flexed, and the knees apart. Anæsthesia is seldom necessary.

FIG. 410.



External version.

A hand is now placed on each pole of the fœtal ovoid, and by steady pressure the head is carried in the direction toward which the occiput points, while the breech is pushed toward the feet. This manipulation is checked from time to time by uterine contractions. Whatever gain has been made in the evolution must be held carefully until the uterus again relaxes, when the effort is continued until a favorable longitudinal presentation is obtained. When either the head or the breech is brought over the brim it should be made to engage, for until the presenting part has entered the superior strait the version is not complete.

This is usually accomplished when external version is made after labor has begun and regular uterine contractions are fully established, or by rupture of the membranes when the version is made during the latter part of the first stage. Under such conditions the head or breech may be crowded into the pelvis by suprapubic pressure with the patient in Walcher's position.

When the presenting part cannot be made to engage, the longitudinal relation of the fœtus must be retained by the application of pads and binder until labor is established, as the causes which had produced the primary malpresentation tend to reproduce it. In certain cases retention of the fœtus in the desired position can be maintained only by rupture of the membranes, an undesirable procedure because of the consequent dry labor.

Bipolar Version was perfected by Braxton-Hicks, who demonstrated the practicability of causing the relation of the long axis of the fœtal ovoid to conform with that of the uterus by combined external and internal manipulation. In Hicks's method the internal fingers do not pass beyond the presenting part.

The advantages of this method are: that it may be accomplished through a dilatation of the cervix that will admit but two fingers, during the first stage of labor, before the membranes have ruptured, or after rupture before the waters have drained away. Done under aseptic precautions there is less danger of infecting the uterus than in the internal method, as the fingers never penetrate the deeper parts of the womb. Shock, traumatism, and danger of injury to the fœtus are diminished. Separation of the placenta and prolapse of the cord are preventable accidents.

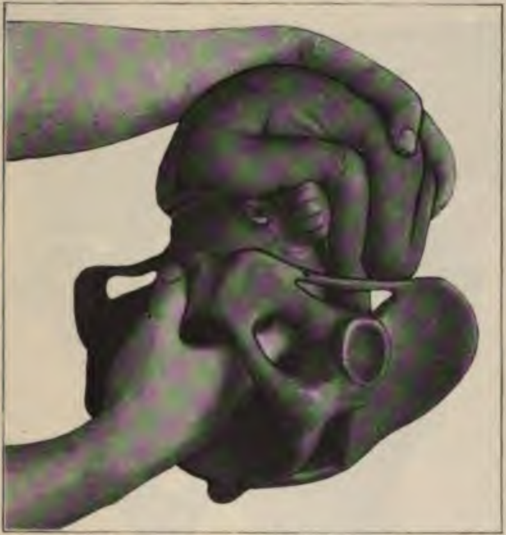
INDICATIONS FOR BIPOLAR VERSION.—Bipolar version is indicated in brow presentations when attempts at flexion and engagement have failed; in occipito-posterior positions of the vertex when postural and manual methods have not succeeded in bringing the head into the brim. In cross-births and in prolapse of the cord with but slight cervical dilatation, before the waters have escaped, bipolar version may be tried. In placenta prævia podalic version by this method brings the breech within the cervix much earlier than is possible by the internal method, securing compression of the placenta and arresting hemorrhage. In all of the foregoing conditions bipolar turning should be the operation of election.

METHOD OF PERFORMANCE. Strict asepsis is imperative. After the bladder and rectum have been emptied the patient is placed across the bed or upon a table, in the dorsal recumbent position, with the thighs flexed on the abdomen, and the vulva, vagina, inner surfaces of the thighs, and the abdominal wall are rendered aseptic. Anæsthesia facilitates the manipulation.

Before operating the diagnosis should be confirmed under narcosis. Care must be taken not to rupture the membranes, as the presence of the amniotic fluid favors easy evolution of the fœtus.

When a cephalic version is to be made by this method, Hicks's clear and concise description will perhaps serve as the best guide: "Introduce the left hand into the vagina, as in podalic version, and place the right hand on the outside of the abdomen, in order to make out the position of the fœtus and the direction of its head and feet. Should the shoulder present, push it with one or two fingers in the direction of the feet. At the same time pressure with the other hand should be exerted on the cephalic end of the child. This will bring the head down to the os; then let the head be received on the tips of the two inside fingers. The head will play like a ball between the two hands; it will be under their command, and can be placed in almost any part of the uterus at will; let the head then be placed over the os, taking care to rectify any tendency to face presentation. It is well, if the breech will not rise to the fundus readily, after the head is fairly in the os, to withdraw the hand from the vagina and with it press the breech from the exterior. The hand which is gently retaining the head from the outside should continue there for some little time, till the pains have insured the retention of the child in its new position and the adaptation of the uterine walls to its new form. Should the membranes be perfect, it is advisable to rupture them as soon as the head is at the os uteri; during and after the escape of the liquor amnii the head will move easily into its proper position." The procedure which has been quoted is so simple that there can be no objection to its trial, for if it fails podalic version may be done without removing the hand from the vagina.

FIG. 411.

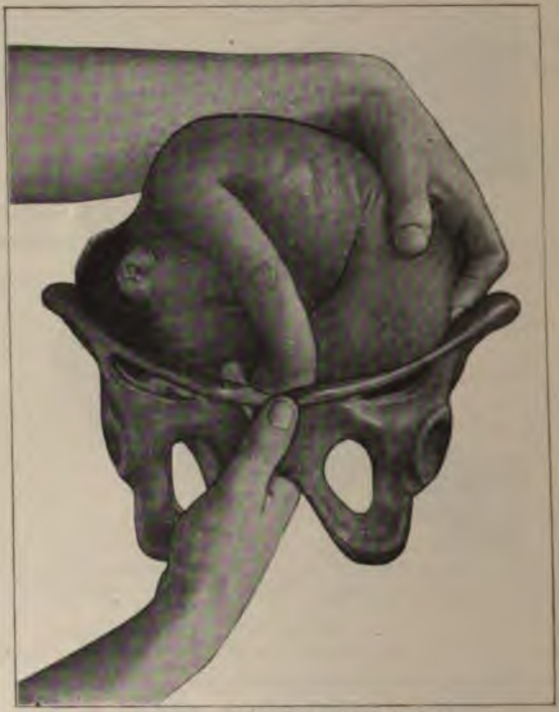


First step in bipolar podalic version. The hand is in the vagina, and the two fingers through the cervix displace the head, while the external hand carries the breech toward the side on which the feet lie.

Podalic version by this method finds more general application. The technique may be described as follows: one hand is passed into the vagina and two fingers through the cervix to displace the presenting part (the head), while the other hand is placed on the outside of the abdomen on the podalic pole. The choice of hands is of some importance. If the occiput is lying to the left, the use of the left hand has an advantage; while if the occiput is to the right, the right hand will more easily displace it into the iliac fossa. With the external hand the breech is pushed toward the side on which the feet lie, while the internal hand tosses the head out of the excavation into the iliac fossa toward which the occiput points. As each successive part of the fœtus presents, it is tossed into the iliac fossa, while the external hand carries the breech into the lower uterine segment until a knee is brought within reach. The membranes are now ruptured and a foot brought down into the vagina. A podalic version is never complete until the breech is engaged.

It is well to make sufficient traction on the presenting leg to bring the knee to the vulva; when this has been accomplished it is evident that the breech has entered the brim. When the evolution is complete the case may be left to terminate unaided as a pelvic presentation, unless need for rapid delivery exists.

FIG. 412.



Second step in bipolar podalic version.

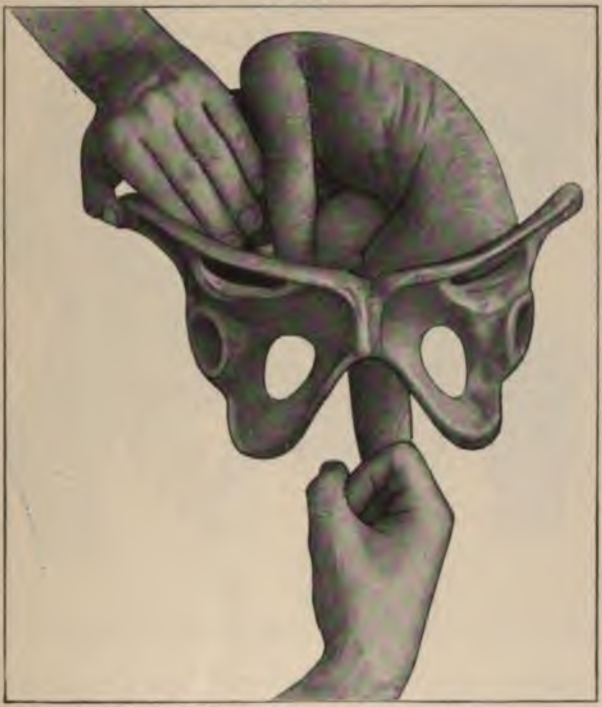
Internal Version. In this method of turning the hand of the operator is passed into the uterus until a foot or both feet can be grasped and brought down through the cervix. This is the most effective and most commonly employed method of version.

INDICATIONS FOR INTERNAL VERSION. Many of the indications have already been mentioned under the general considerations for version. Chief among these are conditions of the mother or child calling for prompt delivery, as eclampsia, placenta prævia, accidental hemorrhage, threatened or sudden maternal death, and prolapsus funis. In malpositions of the head, when attempts at flexion and engagement of the vertex have failed, internal podalic version may succeed when the conjugata vera is above 8 cm. (3.15 inches). The head may then be brought down through the superior strait by its smallest diameters. The head enters the brim as an inverted wedge.

DANGERS AND CONTRAINDICATIONS. This operation should not be attempted before the cervix is fully dilated or dilatable or easily passable for the head without injury.

As the hand is passed deeply into the uterus, the woman is exposed to an increased liability to sepsis and to possible uterine rupture, owing to the additional bulk of the uterine contents. Considerable shock is occasioned by the operation, and too precipitate delivery may be followed by lacerations and post-partum hemorrhage. This operation should never be done in a tetanic uterus with a high and well-developed retraction-ring, nor when the head is firmly impacted in the pelvis.

FIG. 413.

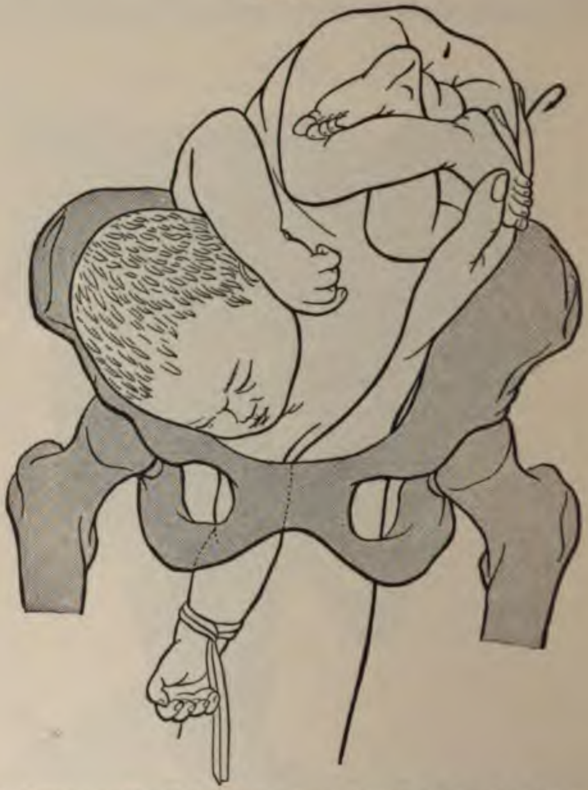


Third step in (bipolar) podalic version.

The ADVANTAGES are the speed and facility with which delivery may be accomplished, owing to the complete control which it affords of the fœtus and its evolution.

METHOD OF OPERATING. Inasmuch as internal combined version has the broadest application and requires the introduction of the whole hand and a part of the forearm into the uterus, it is necessary to impress the reader with the importance of observing the strictest aseptic technique. As internal version is most frequently performed after the membranes have ruptured and the uterus has closed down around the child, surgical anæsthesia will be useful by relaxing the uterus and contributing to the safety and success of the operation. This may be induced either by chloroform or ether, depending on the experience of the operator. Chloroform has, we believe, the advantage, as it relaxes the uterus sufficiently to allow the manipulations necessary to the evolution of the child, while its effect is so transient as not to produce secondary uterine relaxation and hemorrhage. During the past year spinal anæsthesia with cocaine by subarachnoid injection has been employed in obstetrics by Marx and others, with most encouraging results. The safety of the latter procedure has not been sufficiently proved for us to advocate its general adoption in the performance of version.

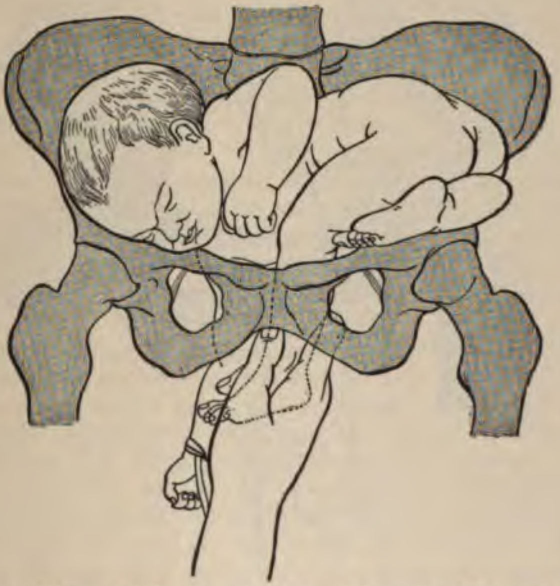
FIG. 414.



First step. Right dorso-posterior with prolapsed arm. A noose is placed on the presenting wrist to facilitate subsequent extraction. (FARABEUF and VARNIER.)

After emptying both bladder and rectum the exact position of the fœtus must be mapped out carefully and the external genitals be made thoroughly sterile. The hair about the vulva is clipped with scissors and the pudendum scrubbed with soap and water, while the patient is being anæsthetized; the soap is then rinsed off with sterile water and the parts bathed with an antiseptic, preferably with a 1 or 2 per cent. solution of lysol, because of its lubricating properties. An ante-partum vaginal douche is unnecessary except in the presence of a purulent discharge from the vagina. The patient is placed across the bed or on a table in the dorsal recumbent posture, with the thighs flexed on the abdomen and the knees held apart by an assistant or maintained in position by the Robb or Bissell leg-holder or a Dickinson sheet sling. The hand is introduced into the vagina until the cervix is reached. If the cervix is not dilated or passable to the hand, its dilatation is at once begun. This may be accomplished manually as described by Harris; or should a constricting ring exist around the os which does not yield to the finger, it may be wise, where it is necessary to expedite delivery, to make six or eight nicks into the hardened ring of the cervix, distributed throughout its circumference. Multiple incisions made on these lines will facilitate dilatation and tend to prevent extensive laceration of the cervix. If the waters have not escaped, care must be taken to preserve the membranes during dilatation. When the os is fully dilated the hand is introduced through the cervix, and the membranes, if still intact, are ruptured. In longitudinal presentation advantage will be gained by using the hand, the palm of which will confront the child's abdomen. The hand is passed deeply into the uterus between the pains. If a contraction of the uterus takes place, the hand must be flattened out and held quiet until the pain has subsided. If the head is in the way, it is pushed to one side in the direction toward which the occiput

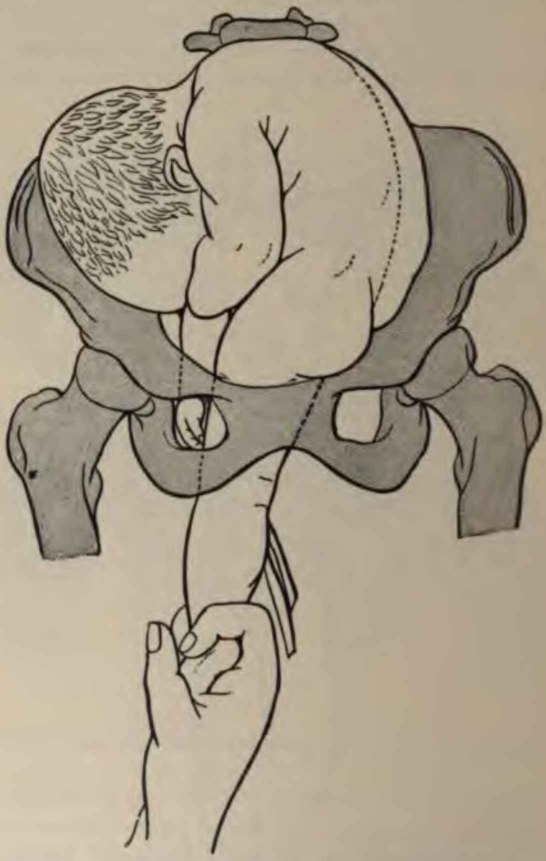
FIG. 415.



Second step. Grasping the upper foot. (FARABEUF and VARNIER.)

points, and the hand passed along until a foot is grasped. Before making traction on the foot the operator should make sure that the cord is not looped over the leg. If it is, it must first be disengaged. "As traction is made on the leg within the grasp of the hand the greatest possible aid may be derived from manipulating the head of the infant toward the fundus with the other hand externally placed on the surface" (Simpson). As the foot is drawn into the vagina and the knee presents at the vulva the head ascends into the fundus and the version is completed. Unless there is some indication for immediate delivery, all traction should cease and the patient be allowed to expel the child spontaneously until the umbilicus is born. This secures a greater dilatation of the cervical canal and produces a paresis of the circular muscle of the cervix which facilitates extraction of the shoulders and the aftercoming head.

Fig. 416.



Third step. Grasping the foot and making traction. The arm ascends as the evolution is completed. (Farabeuf and Varnier.)

In transverse presentation the method already described may be followed; but as the head is in one or the other iliac fossa the hand may be passed directly into the uterus and a foot sought at once. From that moment the operator is master of the situation.

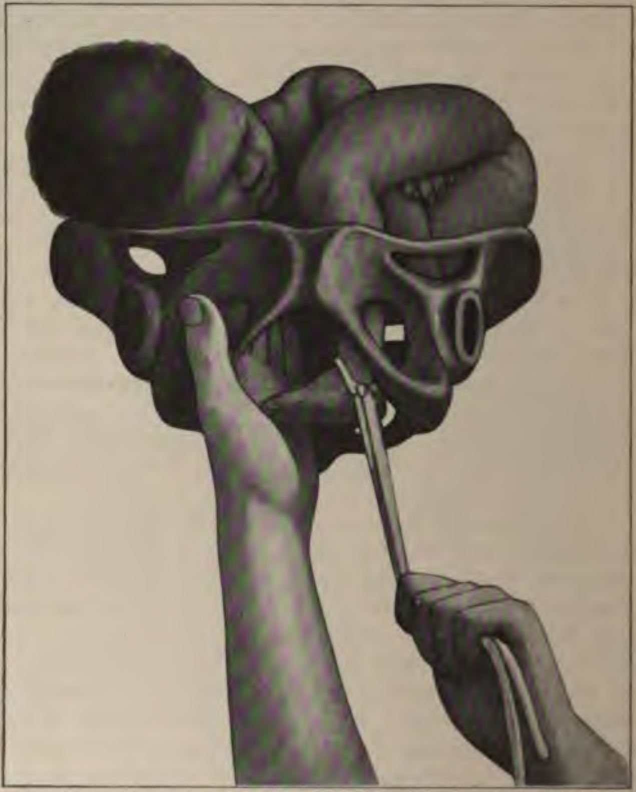
In shoulder presentation where the arm has become prolapsed but has not become impacted, it may be replaced without difficulty and the version proceeded with; yet reposition of the arm is not necessary, for it will be drawn out of the vagina as the fœtus assumes a longitudinal presentation. An expedient which is found useful in the subsequent extraction which commonly follows podalic version is to fasten a loop of tape or a piece of roller bandage around the wrist before the arm is pushed up or drawn up by the evolution of the child; in this way at least one arm may be prevented from becoming extended during subsequent manipulation.

Impacted shoulder presentations afford the obstetrician ample opportunity for a display of his manual dexterity. In such cases the arm has become prolapsed and long-continued uterine contraction has caused the shoulder and thorax to become wedged into the pelvis. In the management of such a malpresentation the thorax must be carried up above the brim and displaced into the iliac fossa before attention is given to the prolapsed arm. This procedure is not only difficult, but dangerous as well, as uterine rupture is almost certain to result unless the greatest care is observed; a tetanic uterus with a more or less perfectly developed retraction-ring is an almost constant complication of impacted shoulder cases. This means that version, if made, must be done in the thinned-out lower segment of the womb.

To relieve such an impaction surgical anæsthesia is required.

If, after making well-directed pressure from below with the hand which corresponds to the prolapsed arm, while firm external counter-pressure steadies the fundus, the impaction cannot be relieved, embryotomy affords the best means of terminating the delivery. In another part of this chapter the relative value of version, craniotomy, and symphyseotomy will be considered in detail. Should it be possible to reduce the impaction of the shoulder and thorax, considerable difficulty may be experienced in completing the version, owing to the tetanic condition of the uterus which prevents the head from ascending to the fundus. Fœtal evolution may be expedited by the use of the following suggestion. For illustration, let us consider a left scapular anterior with a prolapsed arm and impacted thorax. Ether or chloroform narcosis will at least secure partial relaxation of the uterus. The right hand of the operator is now placed in the fœtal axilla just in front of the axillary line, and pressure is made from below upward and the shoulder and thorax pushed toward the mother's right iliac fossa. During this upward pressure the fundus must be held firmly by an assistant. As the shoulder is displaced enough room is gained to allow the hand to pass through the brim and into the uterus to seek a foot; the near foot should have the preference in this position. When the foot is grasped, it may be pulled into the vagina without causing the evolution of the child, as the tight uterus firmly holds the fœtus with its long axis transverse to that of the mother. If a loop of roller bandage is now slipped over the foot in the vagina, traction may be made on it while the other hand of the operator is passed into the vagina alongside of the leg to push each successive fœtal part toward the fundus as it is forced down by the uterus into the brim; in this way the head rapidly ascends and a longitudinal presentation is secured. The force is practically applied to both poles of the fœtus at once; *i. e.*, upward pressure being applied with the left hand in the vagina, while traction is made at the same time on the leg through the use of the bandage traction noose with the right hand.

FIG. 417.



Combined internal version. Applying force to both poles of the fœtus at once.

The Influence of Posture in Facilitating Version. The dorsal position with the hips elevated and well over the edge of the bed or table, the thighs flexed on the abdomen, and the knees widely separated, gives the operator the most direct and ready access to the fundus. During extraction, in bringing the after-coming head into the brim, additional space may be gained in the true conjugate by extending the thighs over the edge of the table (Walcher's position). This lowers the pubes and increases the antero-posterior diameter at the brim by ⅓ to ½ inch (.83 to 1.26 cm.). The knees must be kept well separated, so as not to interfere with the extraction.

Version in dorso-posterior positions and in cases of pendulous abdomen may be facilitated by placing the patient on the side, in the latero-prone posture. She should turn on the side on which that pole of the fœtus lies which is to be brought down; *e.g.*, in a left scapulo-posterior the right latero-prone posture, and *vice versa* in left positions. When operating with the patient in this posture advantage is gained by slipping the hand beneath the child along the lateral aspect of the uterus. The right hand is employed when the patient is lying on her right side, and the left when she is lying on her left.

Either the knee-elbow or the Trendelenburg posture may be utilized with advantage when operating after the waters have drained away and the uterus holds the presenting part snugly against the inlet. In some impacted shoulder cases the Trendelenburg posture in conjunction with ether narcosis makes it possible to relieve an impaction in which repeated efforts with anæsthesia alone have failed. While theoretically the knee-breast position has many advantages over the ones referred to, it is difficult to use it in conjunction with anæsthesia; on the other hand, the Trendelenburg position has all the advantages of the knee-breast, and, in addition, affords greater facility of narcosis. Mensinga has advocated the prone position during version. The superiority claimed for this posture is the same as may be had from the employment of any of those already described when the exact position of the child and the condition of the uterus have been fully determined.

The choice of hand in the performance of version is largely a matter of personal preference. Scientifically, it is dependent on the position of the fœtus and the posture in which the woman is lying. One will naturally use the hand which will pass most easily to the leg to be grasped; this presupposes accurate diagnosis. In cephalic presentation, when the patient is lying across the bed, the hand the palm of which will pass over the child's abdomen may be employed; while in transverse cases the hand which corresponds to the side on which the breech lies has the advantage. These rules apply also when the patient is in either the knee-breast or Trendelenburg posture. Many operators prefer to use the left hand for all versions, as the right hand is usually more dexterous in extraction.

The choice of foot is another question that has given rise to much discussion. In cephalic presentations there is little or no advantage in choosing one foot over the other, as traction upon either foot will rotate the dorsum to the front. In transverse cases it is wise to seize the knee or leg which will maintain a dorso-anterior position or will convert a dorso-posterior into a dorso-anterior; *i. e.*, take the further leg in dorso-posteriors, and the nearer leg when the fœtal dorsum is to the mother's abdominal wall (Hart). The observance of this rule will facilitate anterior rotation during the subsequent extraction.

According to Nagel, it is immaterial which foot is grasped so long as the leg which has been seized is brought forward behind the pubes, and as gradual traction is made between the pains the child's trunk is rotated toward the front.

When immediate and rapid delivery is to follow version the rule is to grasp both feet. This is to be particularly advocated in the presence of a premature, dead, or macerated fœtus. How the leg shall be grasped is another practical consideration which merits description. With the back of the hand toward the uterine wall the foot may be seized between the index and middle fingers of the internal hand, so that the fingers are folded over the os calcis, the dorsum of the foot with the ankle falling between them.

When seizing both feet the middle finger is passed between the child's ankles, and the other fingers are folded so as to surround both ankles.

Maintenance of the proper line of traction contributes to success in version. With the patient on a table traction in the axis of the inlet is possible, and the external hand may simultaneously operate through the abdominal wall to carry the opposite pole toward the fundus. Traction in the axis of the plane of the brim, or more properly in a downward and backward direction, is usually continued until the knee presents at the vulva, which indicates that the version is complete, when we pass from version to extraction.

The dangers to the mother from version, already mentioned in this paper, are septic infection, shock, rupture of the uterus, and lacerations of the soft parts. In order to protect the woman from these accidents a conscientious aseptic technique is requisite. The hands of the operator must be stripped of rings, the nails cut and cleaned dry, and the hands and forearms, including the elbow, thoroughly scrubbed with soap and water; ten minutes is not too much time for this detail. The hands and forearms are then rinsed in sterile or running water, and when possible immersed in alcohol to free them from all fat and soap; finally they are bathed in a solution of corrosive sublimate, creolin, formalin, or lysol; the latter possesses lubricating as well as strong antiseptic properties. For still further security the obstetrician should, if possible, wear rubber gloves with gauntlets.

Disinfection of the external genitals and immediate surroundings must be carried out after the bladder and rectum have been emptied. The hair should be clipped from about the vulva and the pudendum scrubbed with soap and water; the cleansing should include the abdomen and the inner surfaces of the thighs. After rinsing off the surplus lather with sterile water all of the cleansed surfaces are washed with the antiseptic solution.

If the reaction of the vaginal secretion is acid, no preliminary douching is necessary; on the other hand, if the vaginal secretion is purulent or alkaline in reaction, the passage must be thoroughly cleansed with soap and water, followed by an antiseptic douche. If the membranes have ruptured and the waters drained away, or considerable time has been spent with the hand in the uterus, or the placenta has been removed manually, a post-partum intra-uterine douche may be given.

Shock may be guarded against by the timely use of strychnine, minute doses of morphine, and the introduction of a hot saline solution into the colon, or, where more prompt action is needed, directly into the cellular tissues, behind the mammary gland, or into a vein.

Version is especially dangerous when done after the amniotic fluid has drained away and a retraction-ring has developed. Under such conditions the uterus is in a state of tetanic spasm, the greater part of the child being in the thinned-out lower segment of the womb.

Neglected shoulder presentations constitute a most dangerous class of cases, and when a retraction-ring is appreciable between the pubes and umbilicus, with the patient anæsthetized, craniotomy or decapitation should be elected in lieu of version, to insure the best interests of the mother.

It is often possible to secure complete relaxation of the uterus under chloroform, and then with care and patience to succeed in bringing about the evolution of the child. The employment of the Trendelenburg posture adds greatly to the facility with which this may be done. Firm counterpressure must be made on the fundus to prevent the uterus being torn from its vaginal attachments during the upward pressure necessary to introduce the hand past the presenting part. After getting the hand in the uterus, if it is found that the child is dead, or that the lower segment is excessively thinned, or that the fœtus is hydrocephalic or a monster, version should not be made.

The injuries and lacerations to the soft parts following version and extraction consist of tears of the cervix, vagina, and pelvic floor; these are produced by rapid delivery through undilated passages. When time permits, a spontaneous birth after version may prevent many of these injuries.

Prompt suturing of the perineal and vaginal tears protects the patient against sepsis. It is unwise to suture cervical lacerations unless hemorrhage is of sufficient moment to demand it.

Version and extraction through partially dilated passages expose the infant to the danger of asphyxiation. The operator must be prepared to combat this mishap, and have at hand means of resuscitation, which may be employed without delay. Two hæmostatic forceps will be found useful to clamp the cord, two small bath-tubs, one containing hot and the other cold water, ready for alternate immersion of the child, and a warm blanket to receive it, are among the ordinary requisites of the lying-in chamber. Many children may be saved by the prompt institution of one of the methods of artificial respiration. Schultze's method, or mouth-to-mouth insufflation, is to be given the preference. In using Schultze's method expiration should be the first act, as in this way the respiratory passages are emptied of inspired mucus; it is also important to prevent chilling of the body by frequent immersion in warm water.

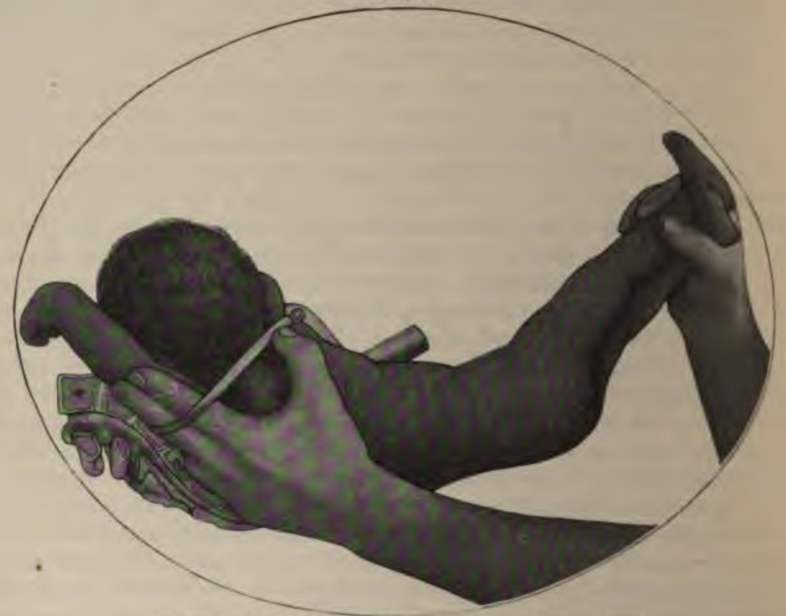
Shall Immediate Delivery Follow Version? As a rule, the two operations should be separated and spontaneous delivery encouraged. This must depend, however, upon the conditions in the particular case. If after cephalic version the head becomes flexed and engages, the labor may be left to itself or be terminated by forceps should the condition of either mother or child call for prompt extraction. On the other hand, if the head will not enter the brim as either a vertex or a face, podalic version is available.

To estimate the relative proportion between a flexed head and the pelvis in a given case, the patient should be in Walcher's position under an anæsthetic and the bladder and rectum empty. The sterile hand is then introduced into the vagina, and the head grasped and held in flexion, while the external hand attempts to crowd the flexed head into the pelvis. The axis-traction forceps will occasionally succeed in bringing the head into the superior strait when other methods have failed. If the existence of positive disproportion has been demonstrated and the conjugata vera is not below 3.15 inches, podalic version and extraction of the after-coming head may be successful, as the diameters of the cranial vault diminish by compression as the head passes through the pelvis.

Extraction after podalic version may be immediate or deliberate, depending on the existing conditions in the particular case.

Accidental hemorrhage, placenta prævia, eclampsia, and prolapse of the cord in transverse presentations may demand rapid delivery; but the degree of dilatation should largely govern the election of the rapid or deliberate method. The writer is of the belief that one of the most fruitful causes of stillbirths is the habit of many practitioners to terminate labor immediately upon turning the fœtus, before complete canalization of the passages. Extraction under such conditions may be complicated by fractures of the femora and humeri, and by asphyxia of the infant. In one instance the writer saw the head severed from the body during an attempt at rapid delivery through incompletely dilated passages.

FIG. 418.



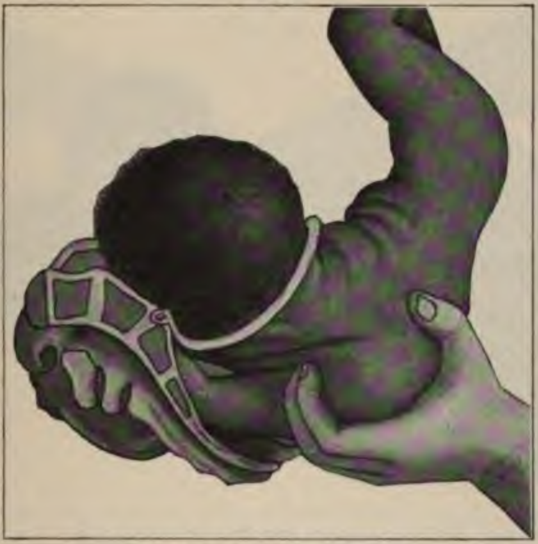
Delivery of the first arm. Carrying the arm past the head.

When version has been completed the operator should note the fœtal heart-rate and the general condition of the mother before determining the advisability of immediate or deliberate delivery. Wherever possible without compromising the interests of either, spontaneous delivery should be elected. The physician should be ready with sterilized hands and instruments to terminate labor at once in case of impending danger to either mother or child.

No discussion of version would be complete without briefly considering the methods of extraction which may accomplish rapid and safe delivery. While we have attempted to separate the two operations, each having its indications and limitations, the one follows the other with such frequency that many have come to assume that version includes extraction.

To perform rapid extraction, the patient must be brought across the bed or placed in the lithotomy position on a table. An anæsthetic is not always necessary; but if one has been employed during the version, it may be continued until the extraction is completed. When the foot emerges from the vulva it is wrapped in a warm towel and grasped by the operator, and traction is made in a downward and backward direction, in the axis of the brim, while an assistant makes well-directed pressure on the child's head to maintain flexion. This external pressure must be continued throughout the operation. As the buttocks emerge from the vulva the index and middle fingers of the hand which corresponds to the flexed thigh are slipped into the groin and the hip lifted out; the pelvis is then grasped with both hands and traction continued, while the body is rotated into the oblique diameter of the pelvis, keeping the back well to the front. When the body is out it is carried upward over the pubes to disengage the flexed thigh and make it clear the vulva.

FIG. 419.

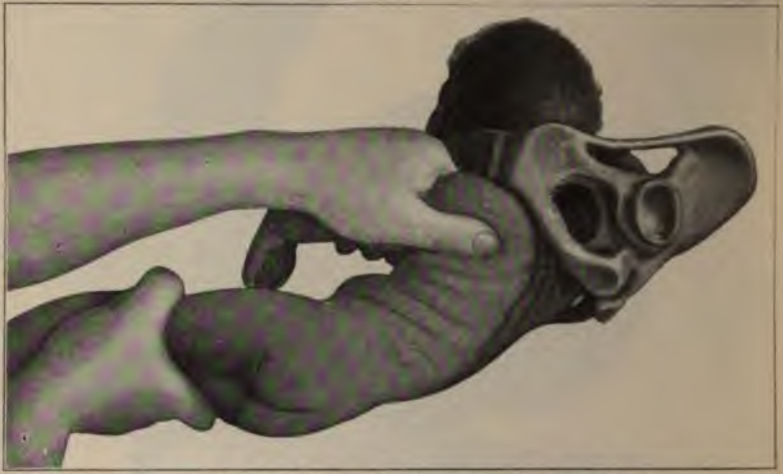


Delivery of the first posterior arm.

As the shoulders engage at the superior strait the posterior shoulder strikes the pelvic floor first, and is shunted downward and inward until it is within easy reach. The rear arm therefore is more easily liberated. If the assistant has succeeded in maintaining flexion by suprapubic pressure, the arm may be found flexed on the chest. It is common experience, however, that one or both arms slip up and become extended. To liberate the posterior arm, the feet are seized, and while making traction the body is carried over to the side opposite the occiput. This causes the posterior shoulder to come into the median line within reach, the fingers of the free hand are passed along the dorsum to the shoulder and up the humerus to the elbow-bend, which is drawn downward, flexing the forearm across the face and chest of the child (Fig. 419).

To deliver the second arm, seize the trunk with both hands and push it up in the axis of the brim, to release the extended arm from the grasp of the pelvis, and at the same time rotate the body so as to bring the extended arm to the rear. This rotation may be assisted materially by grasping the delivered posterior shoulder and using it as a rotator. When the second arm has been brought to the sacral side the legs and trunk are carried to the opposite side, while the free hand sweeps the second arm and forearm across the chest (Fig. 420).

FIG. 420.



Delivery of the second arm, using the delivered arm as a rotator.

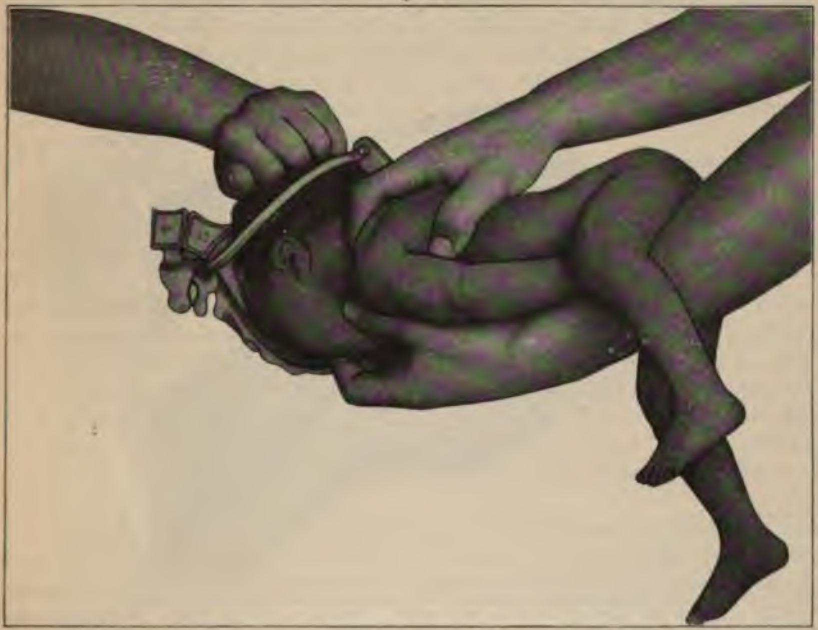
When the arms have been delivered there is usually little time to extract the head; this may be done either manually or instrumentally. The body is wrapped in a warm towel and laid upon the forearm of the operator, while the hand is passed into the vagina along the sacrum until two fingers can be hooked into the canine fossæ or the mouth, to maintain flexion and keep the long axis of the head in the oblique diameter of the pelvis. If the head has not engaged, suprapubic pressure with the closed hand may force the head into the brim. As the head reaches the pelvic floor traction is made by two fingers placed astride of the neck, and the body is carried upward and forward over the maternal pubes (Fig. 421).

In flattened pelves care must be taken to rotate the long axis of the child's head into the transverse diameter of the brim, and to have the patient in Walcher's position, in order to facilitate its engagement.

The management of the cord during extraction is of primary importance. When the breech has been delivered the cord should be pulled down and its pulsation noted; in case of short cord it should be secured between two artery-clamps and cut. When it is possible the cord should be placed in that part of the pelvis in which it will have the most room; this is generally in the space opposite the sacro-iliac joint which is not occupied during the passage of the head; *i. e.*, if the head is coming through in the right oblique diameter, the cord will be out of danger if it is placed opposite the left iliosacral joint.

Delivery of the after-coming head may be accomplished without difficulty, except in the presence of a large head or a contracted pelvis, if the steps of the mechanism are kept constantly in mind; *i. e.*, to engage the head, it must be flexed and rotated into one or the other of the oblique diameters at the brim. Rotation may be aided by manipulation through the abdominal wall with the external hand. The forceps should always be ready to terminate delivery in case of failure with manual methods.

FIG. 421.

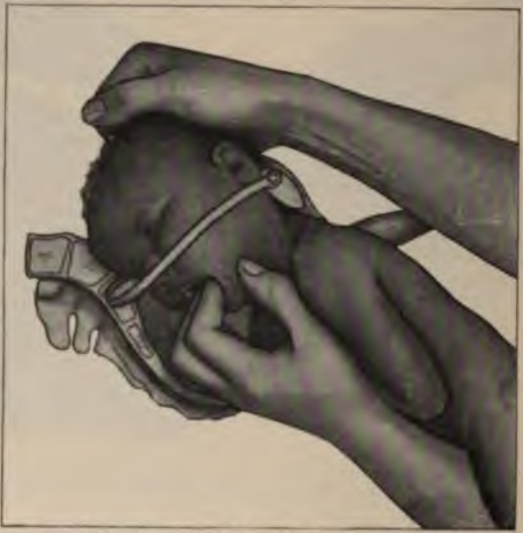


The Smellie-Veit method of extracting the after-coming head, augmented by suprapubic pressure.

Extensive lacerations of the pelvic floor may be avoided if, after the mouth is delivered, time is taken to stretch the posterior segment of Hart, by holding the head before letting the suboccipito-frontal and suboccipito-bregmatic diameters pass through the vulva. Notwithstanding the employment of skill and care, rapid extraction of the fœtus at full term is rarely accomplished without extensive laceration of the maternal soft parts. These injuries, if the mother's condition is such as to warrant further procedure, should immediately be repaired. The presence of shock or the want of proper assistance and aseptic suture-material should postpone restoration; yet bleeding points that may give troublesome hemorrhage are to be secured at once. Primary suture of tears in the cervix is of doubtful value in private practice; only when the rent has severed the circular artery is suture positively indicated.

Internal version followed by rapid extraction exposes the woman to the possibility of partial or complete separation of the placenta ante partum, which complicates the delivery with more or less hemorrhage. Even when no separation of the placenta has taken place immediate and rapid delivery increases the tendency to post-partum hemorrhage, since the uterus is not given time during the second stage for proper retraction and rearrangement of its fibres, such as take place when the expulsion is spontaneous. Upon delivery of the child the uterus must be grasped through the abdominal wall and stimulated to contraction. If it does not promptly retract and all bleeding cease, manual expression of the after-birth will conserve the best interests of the mother. Every ounce of blood lost increases the shock.

FIG. 422.



The Wiegand-Martin method of extracting the after-coming head.

When turning and extraction have been done for placenta prævia or accidental hemorrhage, an intra-uterine tamponade of iodoform gauze stimulates the uterus to contraction and maintains retraction, safeguarding the patient against further loss of blood, and by securing a tight uterus tends to fortify her against sepsis. The hypodermic use of strychnine over the womb in doses of $\frac{1}{15}$ grain, repeated every two hours for three doses, corrects any tendency to relaxation. The effect of strychnine is superior to that of ergot, as it establishes a steadier and less spasmodic contraction of the uterine muscle.

The complications of version, made so much of by some writers, are chiefly encountered when the operation is badly chosen. When the diagnosis of position has been made, the indications and contraindications thoroughly considered, and due care is exercised in its performance, rupture of the uterus and separation of the womb from its vaginal attachments will be less common sequelæ than a perusal of the literature would lead us to suppose. Unusual and complex presentations of the fœtus, such as a transverse with prolapsed arm and foot, or twins lying crosswise in the uterus, may seriously embarrass the operator; but with the proper appreciation of existing conditions and by patient and persistent work under complete narcosis these complications may be overcome and a longitudinal presentation be substituted.

The Influence of Ventro-fixation and Vagino-fixation upon Version. Since these two operations have been practised for the correction of retrodisplacements of the uterus, many labors taking place in uteri firmly fixed to either the abdomen or vagina have been complicated by malpresentations of the fœtus. The posterior wall of the uterus is subjected to extreme dilatation at the expense of its muscular strength, as the anterior wall which is fixed by adhesions does not participate in the uterine growth. Version in a uterus that is almost wholly developed from its posterior segment is fraught with danger of rupture. In such cases considerable difficulty has been experienced in getting the presenting part to engage when pregnancy has occurred.

When malpositions exist which necessitate turning advantage will be gained if the operation is done early, by the bipolar method, before the membranes have ruptured. When the waters have drained away version can be most satisfactorily made with the patient in the latero-prone posture.

The Relative Value of Version, Forceps, and Symphyseotomy. Forceps and version find their widest application in border-line contractions of the pelvis and in malpositions of the head when the pelvis is ample. Properly symphyseotomy should not be compared with version, as its field of application is more limited, and a degree of contraction which indicates pubic section, contraindicates turning. The field of symphyseotomy begins where that of forceps and version ends; *i. e.*, with a conjugate of less than 3⅛ inches.

In flat pelves of moderate contraction version has an advantage over forceps, as the long occipito-mental diameter of the fœtal head can be brought into the transverse of the inlet and the occiput guided through the roomiest part of the brim. On the other hand, in slight general contraction forceps used in conjunction with the Walcher posture offers the best prognosis for both mother and child.

The comparatively recent researches of Milne Murray show that all of the diameters of the cranial vault are reduced by an occipito-frontal seizure with the forceps; thus the supposed advantage of version, the overlapping and under-riding of the cranial bones, is controverted by practical experience. The dexterity and practice of the operator must also be taken into consideration in determining the relative value of forceps and version. The expert with the axis-traction forceps may be able to bring a head through the superior strait that one less skilled might sacrifice. However, the general rule for emergencies still holds good; *i. e.*, that where rapid delivery is demanded and the head has not engaged at the pelvic inlet version is the operation of choice, while forceps is to be chosen when the head is in the brim.

Version has been successfully done in conjunction with symphyseotomy, but the liability to produce extensive lacerations of the soft parts does not justify its general use. Pinard's method is based on better surgical principles. He puts each case to the practical test of tentative traction with the forceps with the patient in Walcher's position; if the head cannot be made to engage, pubic section is made while the forceps is in position.

CHAPTER XXXIII.

EMBRYOTOMY.

EMBRYOTOMY is a term applied to destructive operations on the fœtus by which the size of the head and trunk is sufficiently diminished to permit their passage through the birth-canal. It is a generic term which includes all operations designed to facilitate delivery by perforation, crushing, or segmentation of the fœtus.

Perforation, cranioclasis, cephalotripsy, and basiotripsy are the mutilating operations performed upon the head. Those on the body include decapitation and evisceration.

In the present state of obstetric surgery embryotomy has but a limited field. As the head presents in the majority of cases, craniotomy has the widest range of application.

Craniotomy.

Indications for Craniotomy. Craniotomy is indicated in: 1. Disproportion between the size of the fœtal head and the pelvis if the child is dead. 2. In pelvic deformity, in which the conjugata vera exceeds 2½ inches, or 6.34 cm., and forceps, version, or Cæsarean section is either impossible or dangerous to the mother. 3. In the presence of tumors complicating labor by narrowing the birth-canal, as malignant disease of the cervix and bony growths in the pelvis, when Cæsarean section cannot be elected. 4. In prolapsed cord, when the head presents in a contracted pelvis with a dead child. 5. Perforation and cranioclasis may be done in certain cases of lateral placenta prævia in which the child is surely dead or non-viable. 6. In dystocia due to hydrocephalus not manageable by aspiration through the bregma in the forecoming head, or by tapping through the spinal canal when the head comes last. 7. In impacted posterior face presentation and in occipito-posterior cases when their reduction is impossible or the election of symphyseotomy would be unfavorable to the mother. 8. In brow presentations after the membranes have ruptured, the amniotic fluid has drained away, and a well-marked retraction-ring is formed.

Is Craniotomy Ever Justifiable on the Living Child? Stoltz and Pinard have declared that it is never necessary to have recourse to destructive measures on the living child, and some writers go so far as to say that "any man who, in the light of recent researches, deliberately sacrifices an unborn child simply confesses his ignorance of the progress of obstetrics." There can be no question that during the past decade elective Cæsarean section, induction of premature labor, and the reintroduction of symphyseotomy have narrowed the field of destructive operations. But do the results of conservative operations show that the mother has as good a chance from Cæsarean section as from craniotomy? It must be admitted that in hospital practice, with every facility for aseptic operative work, and where a diagnosis of pelvic deformity can be accurately made before labor, elective Cæsarean section has a very low mortality.

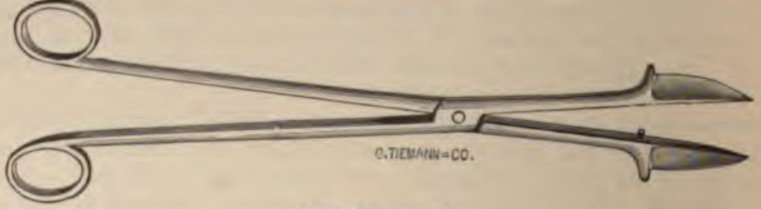
In private practice craniotomy, which saves the mother, is preferable to symphyseotomy or Cæsarean section, which gives considerable mortality. The interests of the mother must always take precedence over those of the unborn child.

In country practice, where the aid and counsel of a skilled associate cannot be had, mutilation may be considered, after a full explanation of the relative merits and dangers of the life-saving operations has been made to the patient or her family. The author fully believes that the untrained physician with incompetent assistance should not elect symphyseotomy or Cæsarean section, as two lives instead of one are almost sure to be sacrificed by unskilful operation.

Craniotomy is to be preferred to all other operations when the child is in danger, and the mother is ill and exhausted or threatened with uterine rupture. It has been suggested that the physician might delay operation until the child is known to be dead, and then craniotomize. This is dishonest and a violation of duty, for not only is the life of the child sacrificed, but the mother is exposed to the dangers of post-operative shock, sepsis, and uterine rupture following upon a tedious labor. There is really no reason that pelvic deformity sufficient to necessitate embryotomy or Cæsarean section should not be recognized before labor begins, if routine ante-partum mensuration is practised, except in cases seen with other physicians in consultation. If repeated and unsuccessful applications of the forceps have been made, the patient is already septic, and any life-saving operation will increase her risks.

Prognosis of Embryotomy. It must be remembered that embryotomy in a highly contracted pelvis is not without risk to the mother because of the extensive lacerations of the cervix, vagina, and bladder that may be made in bringing a fœtus piecemeal through so limited a space. The bruising and laceration of the soft parts lower the resistance of the tissues and predispose the patient to active septic infection. The success or failure of embryotomy depends upon the indications and the conditions in the particular case; *e. g.*, the condition of the mother at the time of operation, the size and the shape of the pelvis through which the work has to be done, and the method of extraction after perforation has been made. The result is most favorable when that method of extraction is used which will do the least injury to the soft parts of the mother.

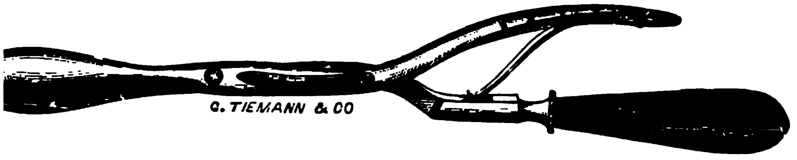
FIG. 423.



Smellie's scissors.

In estimating the prognosis of embryotomy the following conditions t be taken into account: The degree of pelvic contraction, the size ie child, the manual skill of the operator, the physical condition he patient, and the amount of bruising and laceration which she

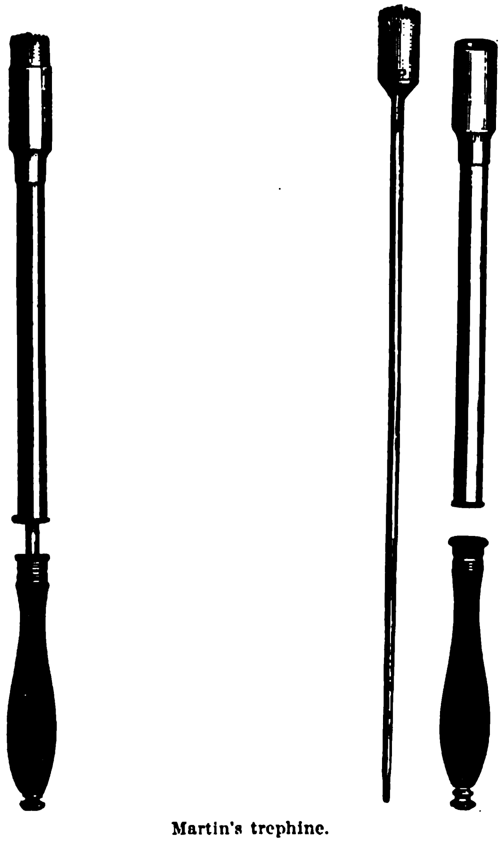
FIG. 424.



Blot's perforator.

sustained before the operation is begun. Previous unsuccessful npts at delivery with forceps and version tend to increase the tality when embryotomy is performed.

FIG. 425.



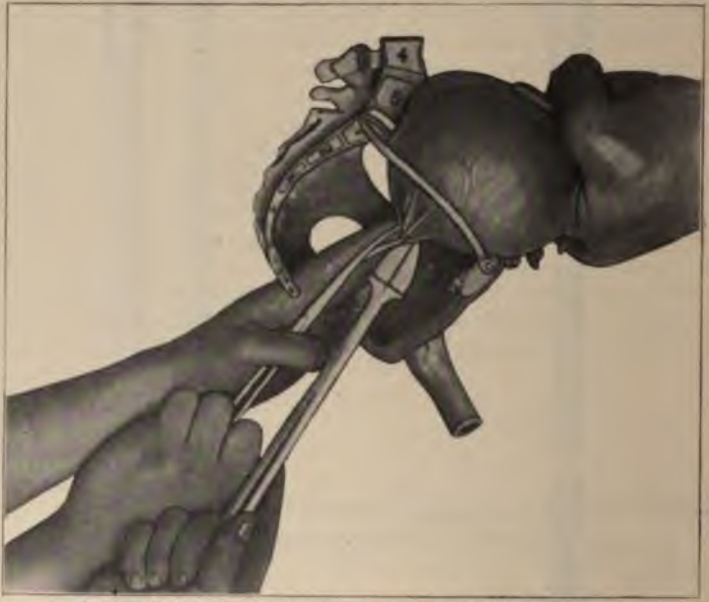
Martin's trephine.

echnique of Craniotomy. Mutilation of the head is accomplished by oration and comminution. The perforation may be made with sors, a perforator, or a trephine (Figs. 423–425). Comminution of the cranial vault with short craniotomy forceps has given place to the employment of the cephalotribe and basiotribe, which are used to compress, crush, and extract. The cranioclast is a tractor. Decapitation is performed with the blunt hook or écraseur. An ordinary pair of strong scissors and a stout, straight forceps are all that is needed for evisceration.

After thorough sterilization of the operators' hands, instruments, and passages, the bladder and rectum having previously been emptied, the patient is placed on a table and anæsthetized. When the narcosis is complete she is brought to the edge of the table in the lithotomy position, and the flexed thighs held by two assistants or retained in position with a sheet-sling or leg-holders.

If the head is impacted in the cavity of the pelvis, perforation will be easy; on the other hand, if the head is unengaged, it must be firmly held against the brim by a competent assistant while the perforation is being made. In the absence of proper assistance the skull may be fixed by seizing the scalp with a strong double tenaculum and the cranial opening made, even without anæsthesia (Fig. 426).

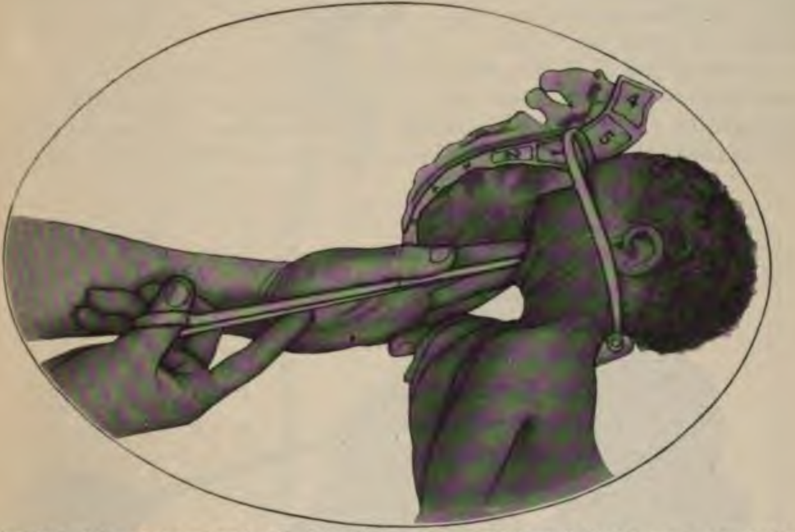
FIG. 426.



Fixing the head by seizing the scalp with a double tenaculum.

To perforate, the half hand is introduced into the vagina and the presentation, position, and posture reascertained. If the disproportion between the head and the pelvis is not too great, the head may be opened through a fontanelle or suture; but if the disproportion be considerable, a permanent opening would better be made through one of the parietal bones. With the fingers in the vagina against the presenting part, to act as a guide, a perforator or trephine is introduced, guarded by the fingers, and plunged into the skull. The greatest care should be taken to keep the instrument at a right angle to the surface of the skull, as otherwise the instrument may slip between the scalp and the cranial bones without entering the head. If a suture is not accessible, as is commonly the case in flattened pelves, the hole may be made through the presenting parietal bone. The point of perforation should be nearer the symphysis than the promontory (Fig. 427).

FIG. 427.



Perforation of the after-coming head. The scissors are passed through the pharynx or roof of the mouth.

When the perforating scissors have been passed in under steady pressure to the shoulder-guard, the blades are spread apart to enlarge the opening; then closed and turned at right angles to the original incision, when the blades are again separated. In this way a crucial incision is secured. When this has been done the scissors are pushed into the cranial cavity and moved about until the brain is thoroughly broken up; special effort is made to reach and to destroy the medulla. The scissors are now withdrawn and the finger or fingers slipped into the opening to act as a guide through the remaining steps of the operation. A hard-rubber or metal nozzle attached to a Davidson syringe is introduced into the cranium alongside of the finger and the broken-up cerebral matter washed out. Many cases of minor dystocia will be delivered spontaneously after perforation, and only where there is indication for haste, because of the condition of the mother, should extraction immediately follow perforation (Zangemeister). Having thus diminished the size of the head, its delivery is in order; this may be accomplished by nature or by traction with the finger hooked into the cranial opening, the forceps, or the cranioclast.

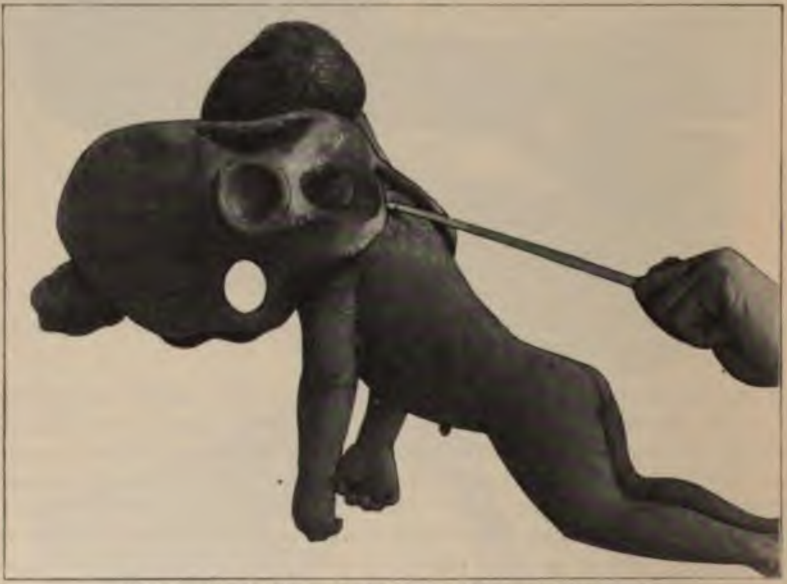
It must be remembered that extraction by any of these methods is possible only in slight disproportion between the head and pelvis, as the reduction in the size of the head is accomplished by the pressure of the walls of the pelvis. When the skull is too hard or too large to come through in this way it must be reduced by comminution or compression.

Perforation may be done without an anæsthetic, and done early when evidence of fœtal death is positive, while extraction always requires narcosis.

Spiegelberg advises that extraction should always follow perforation because: 1. The expelling powers are often inefficient. 2. Prolongation of the operation is always disadvantageous because of sepsis and exhaustion. 3. The opening may close by overlapping. 4. Extraction is not dangerous when done early.

At what point of the fœtal skull should we perforate? In vertex presentations, when a trephine is available, the opening should be made through the presenting parietal bone near the pubes. When the perforation is made with a scissors perforator, a suture or fontanelle is selected as the site of puncture. In face presentations the perforator may be passed through an orbit or one of the frontal bones, or through the roof of the mouth behind the nasal fossa. The guiding fingers must not be withdrawn from the vagina until the cranioclast or basiotribe has been applied.

FIG. 428

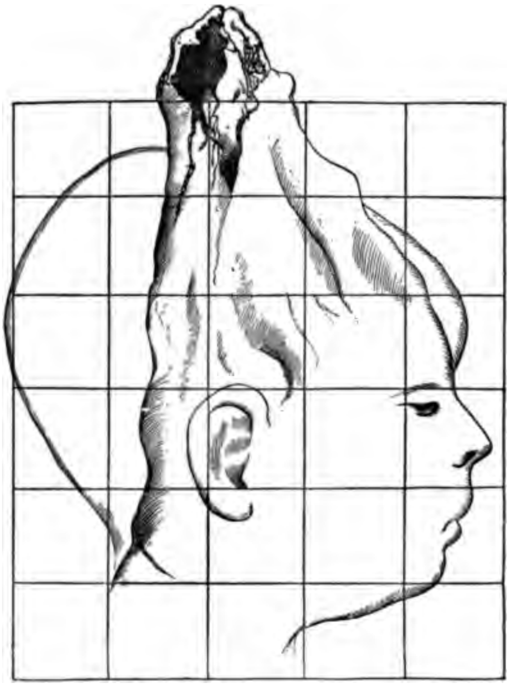


Entering the skull through the occipital bone subcutaneously.

After perforation of the skull its size may be reduced by comminution with the craniotomy forceps. The cranial bones are seized with forceps, which is passed beneath the scalp; the instrument is rotated in its long axis until the bone is detached and can be withdrawn. The maternal soft parts are protected by the scalp during the torsion, and by the fingers within the vagina during the extraction of the bone. The bones are removed one by one until the size of the head permits its extraction. It may be necessary in the higher grades of pelvic contraction to crush the cranial base as well as the vault. The basiotribe is useful for this purpose.

Cranioclasis. One blade of the cranioclast is introduced through the opening in the cranium, which has been kept patulous by the guiding fingers, while the other blade is applied to the external surface of the head. The instrument is then firmly locked and the compression screw in the handle turned home. With the firm grip thus secured traction may be made downward and backward in the axis of the pelvic brim until the head is brought to the pelvic floor, when the traction is continued in an upward and forward direction, as in ordinary forceps delivery. Cranioclasis after careful comminution with the craniotomy forceps is applicable even in high degrees of pelvic contraction.

FIG. 429.

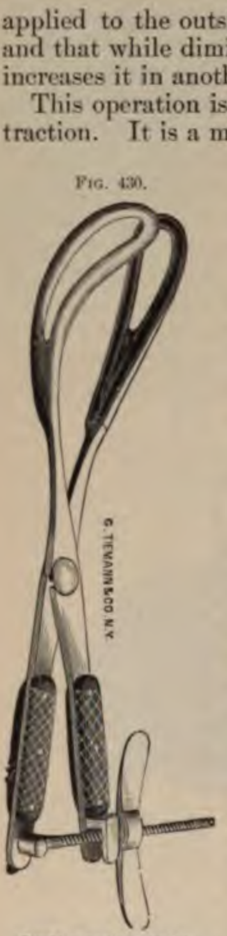


The head after delivery by the cranioclast.

Cephalotripsy.

The purpose of this operation is to crush the skull in order to permit its passage through the birth-canal, when this cannot be accomplished by the cranioclast. The cephalotribe (Fig. 430) is a powerful compressing forceps with a strong compression screw at the end of the handle. It is applied to the sides of the head as is the ordinary forceps. Perforation is, of course, the initial step as in craniotomy. The advantage claimed for the cephalotribe is that it enables the operator to overcome the difficulties presented by a fully ossified head, in that it can be used as a crusher as well as a tractor. On the other hand, it has the disadvantage that, since it is a bulkier instrument than the cranioclast, and since both blades are applied to the outside of the skull, it occupies more room in the pelvis, and that while diminishing the diameter of the head in one direction it increases it in another.

Fig. 430.



Lusk's cephalotribe.

This operation is applicable only in the minor degrees of pelvic contraction. It is a more dangerous procedure than cranioclasis, owing to spicula of bone which are likely to project as a result of the forcible crushing, and also because of the increased room needed for its application, both of which causes will subject the maternal parts to greater traumatism. After the compression screw has been sufficiently tightened, keeping in mind that the crushed cranium is elongated in the diameter opposed to that in which the crushing force is applied, traction is made in the axis of the brim, adjusting by rotation the long diameters of the crushed head to the long diameters of the cavity and outlet. After perforation, cranioclasis, cephalotripsy, or basiotripsy an antiseptic intra-uterine douche or one of sterile water completes the operative technique.

Occasionally neither cranioclasis nor cephalotripsy will succeed in crushing the portion of the occipital bone which forms the base of the cranium. If it is necessary to reduce the size of the base, the occipital bone must be crushed. The Tarnier basiotribe was devised to attain this end. This instrument is at once a perforator, cranioclast, and cephalotribe. Its chief advantage is that it may be used in a pelvis of such contraction that neither cephalotribe nor cranioclast can be employed; even in a pelvis having a true conjugate of 1$\frac{3}{4}$ inches (4.44 cm.) its application is possible. Embryotomy through a brim of so high contraction should be condemned on general principles. Two and one-half inches should be accepted as the limit for successful basiotripsy; the damage to the maternal soft parts even with such a conjugate will be considerable.

The basiotribe is composed of a perforator, two blades of unequal length, and a powerful compression screw attached to the handles (Figs. 431, 432). When closed and the compression screw is turned home the blades measure from side to side 1$\frac{1}{2}$ inches, and from before backward 1$\frac{3}{4}$ inches. Its application is as follows: the perforator is bored through the cranial vault and into the base of the skull; when this is driven home the blades are applied to each side of the skull, locked, and the compression screw tightened until the base is thoroughly crushed. Extraction is then completed as when the cranioclast or cephalotribe is used.

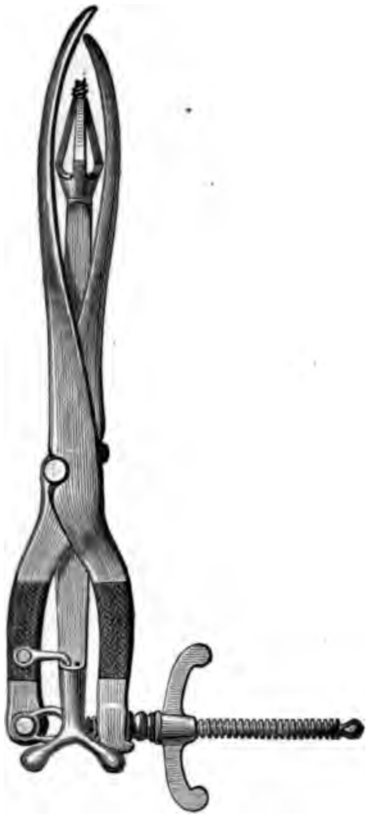
Decapitation.

Decapitation, or the removal of the head from the body, is an operation which is fortunately rare in modern midwifery, because of a more accurate diagnosis and earlier interference on the part of the physician than formerly in transverse presentations of the fœtus.

The indication for performing such mutilation is a neglected transverse presentation which has become impacted, fœtus dead, and a retraction-ring so well defined that rupture of the uterus is imminent and version positively contraindicated.

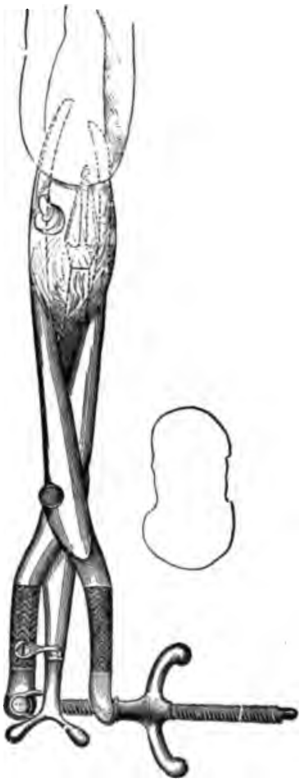
Fœtal monstrosity may render delivery impossible except by decapitation or evisceration. In transverse cases which justify such procedures the position of the neck will determine which is the more feasible. Where the neck is accessible and a hook can be passed over it, decapitation is the operation of choice; on the other hand, when the neck of the fœtus cannot be reached evisceration is the operation of election.

FIG. 431.



Tarnier's basiotribe.

FIG. 432.

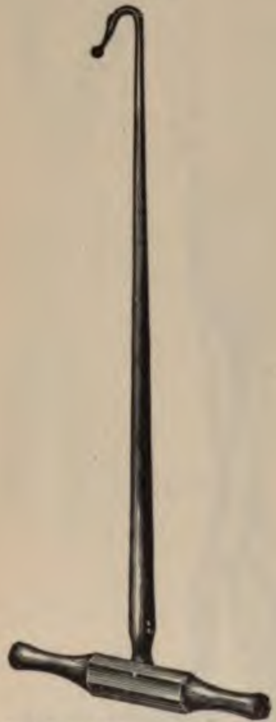


Basiotripsy accomplished.

Braun's decapitating hook, or *decollator*, is the most efficient instrument yet devised to divide the vertebral column. This consists of a steel rod fitted with a strong transverse handle at one end and a short blunt hook at the other. The hook forms an acute angle with the shaft of the instrument (Fig. 433). The hook is passed over the neck of the child and pulled down until the neck rides well up into the apex of the angle. Then by a steady pendulum motion, accompanied with traction on the handle, the neck is severed.

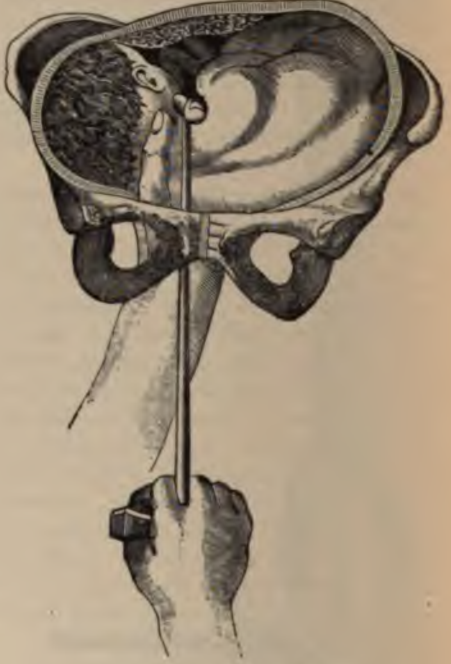
A strong cord or a chain-saw may be utilized to behead the fœtus when a decapitating hook is not at hand, if the neck is sufficiently accessible to permit of its passage above it, or the passage of a well-lubricated elastic catheter, to which the cord or saw may be attached and carried into place. This procedure is always attended with considerable difficulty, owing to the skill and patience which are required to pass either catheter, cord, or saw about the neck. A knot or a loop at the end of the cord facilitates the manipulation. When the cord has

FIG. 433.



Carl Braun's decapitation hook.

FIG. 434.



Decapitation by the hook.

been put in place the two ends are to be brought out of the vagina and a tubular speculum passed over the ends and into the vaginal orifice, to protect the tissues while the neck is sawn through.

To insure the safety of the mother during decapitation a most scrupulous aseptic technique is imperative. Since these patients are often already septic and lacerated to a greater or less degree, further infection and traumatism to the maternal soft parts must be carefully guarded against. After the bladder has been emptied the hands of the operator, instruments, and the field of operation are rendered aseptic and the patient anæsthetized and placed in the lithotomy position. A fœtal arm, if accessible, is brought out of the vagina and given to an assistant to make traction on, in a downward and backward direction. This steadies the neck and brings it within reach. A noose of tape looped about this arm facilitates the subsequent manipulations, by permitting downward and backward traction to be made on it, without the assistant being in the way of the operator. The operator inserts his half or whole hand into the vagina. The right hand is chosen if the head is to the mother's left, and the left when the head is to the mother's right. Two fingers are now passed along the pubic or sacral wall of the pelvis and into the uterus until they can hook over the neck. If the dorsum is to the mother's front, the fingers may be passed along the pubic side; if to the mother's back, advantage will be gained by carrying the hand along the sacrum.

The hook is now run in flat, along the fingers, and guided around the neck from above downward. When in place firm traction is made upon it, while the hook is rocked back and forth until the neck yields. The fingers must be kept in position to guard the maternal structures from injury.

After the head is severed from the trunk the body may be delivered by traction on the prolapsed arm and the head slips upward as the trunk glides by. The head may be extracted by seizing the inferior maxilla with the fingers to maintain flexion and control rotation while suprapubic pressure is made with the other hand, or by forceps if the pelvis be sufficiently ample to permit cephalic engagement. If, on the other hand, the pelvis is so contracted as to make engagement by the suboccipito-mental, suboccipito-frontal, and bitemporal diameters impossible, the head may be steadied against the brim, perforated, and extracted by cranioclasty or basiotripsy.

Decollation in Locked Twins. Decapitation may be necessary to relieve the impaction in case of twin presentation with locked chins. The child partly born with the breech presenting is usually dead; if it is not, the chance of life is so small that it may be sacrificed in the interest of the other twin. A strong, blunt-pointed curved scissors may be utilized to sever the neck in this location; to prevent the scissors from slipping up and doing damage to the maternal structures, a piece of stout rubber tubing may be tied about the neck, and the vertebral section made below this guard.

Evisceration and reduction in the size of the trunk are elected in certain cases of transverse presentation of the fœtus, in which the neck is inaccessible to the hook, in breech births where the fœtus is too large to pass through the pelvis, or when because of monstrosity or pathological enlargement of the fœtal structures delivery without mutilation is impossible.

The abdomen or the thorax may be opened with blunt-pointed scissors and the viscera removed with the fingers or forceps. The ribs are divided to diminish the size of the chest, and the clavicles severed (cleidotomy) in their middle third to reduce the transverse measurement of the shoulders. Extraction is made with the blunt hook or cranioclast.

When the back of the fœtus presents, making decapitation and evisceration as ordinarily performed impossible, the trunk may be steadied with a strong volsellum forceps and the spinal column divided with scissors; with the trunk thus opened from the back, it may be seized and drawn down by the cranioclast until the body can be snipped through with scissors. The two halves may now readily be reduced and delivered. Should the arms embarrass extraction, they may be amputated.

During decapitation and evisceration the mother is subjected to the danger of sepsis and laceration of the soft parts. The first is guarded against by strict attention to aseptic detail, and an antiseptic intra-uterine douche should follow delivery, when necessary for the removal of loose shreds of tissue which otherwise might be retained. Immediate suture should be made of all accessible maternal lacerations.

Arrest of the after-coming head at the brim or within the cavity of the pelvis may demand craniotomy; under such circumstances the child is usually dead and the indication is clear. Of the various procedures recommended for these cases, the method described by Strassmann is especially safe, thorough, and practical: "The head is fixed by introducing the index and middle fingers into the open mouth and making traction upon the lower jaw. The breech of the child is carried up over the pubes toward the mother's abdomen, and a scissors perforator is then passed through the pharynx to the base of the skull, and through the foramen magnum, dividing the bones between the occipital condyles." A metal catheter is introduced through this opening and the brain carefully broken up and washed out.

To complete the delivery the head is flexed by making traction on the lower jaw with the index and middle fingers, which are introduced into the mouth, while suprapubic pressure is applied with the other hand. Should manual extraction fail, labor may be terminated by the forceps or cranioclast. Perforation through the mouth is usually safe.

Hydrocephalus of an after-coming head, causing dystocia, may necessitate craniotomy, since the position of the head is so high in the pelvis that the mouth is not readily reached. Successful perforation may be made through a skin incision at the base of the neck posteriorly; the perforator being passed under the skin, is made to enter the occipital bone, and extraction is accomplished by the cranioclast.

In minor degrees of hydrocephalus puncture of the spinal canal to allow for the escape of cerebrospinal fluid may reduce the cranial diameters sufficiently to permit their passage through the pelvis. This procedure and aspiration through a fontanelle in the forecoming head do not necessarily cause the death of the child.

Craniotomy in connection with symphyseotomy has been suggested and been performed as an emergency procedure; but such an operative combination cannot be considered as advisable in the light of modern obstetrics.

Embryotomy is generally inadmissible in pelves below 2½ (6.34 cm.) inches, while 2¾ (6.97 cm.) inches is the lower limit for symphyseotomy. *Basiotripsy* followed by evisceration would do less damage to the maternal structures than the above-mentioned combination. The occasion for embryotomy with pubic section could arise only from poor judgment or from a failure to recognize pelvic contraction by previous examination during pregnancy or at the time of labor. So high a degree of contraction as to necessitate these operations should be apparent to the most casual observer. Again, many of these patients are already septic from repeated examinations and ineffectual attempts with forceps and version before symphyseotomy is considered, which fact of itself would contraindicate pubic section.

Prognosis for Embryotomy. In skilful hands and in properly selected cases embryotomy is a comparatively safe operation. The time at which the operation is done, the size of the pelvis, and the condition of the maternal soft parts influence the prognosis. The maternal mortality and morbidity from embryotomy are higher in private than in hospital practice. This is accounted for by the lack of accurate estimation of the relative size of the fœtus and pelvis, which is unfortunately too common in private work, and by the fact that embryotomy is made as an operation of last resort, after ineffectual attempts at delivery with forceps, in an exhausted, septic, and lacerated woman.

Choice of Procedure. The higher degrees of contraction which call for basiotripsy and evisceration increase not only the mortality, but also the morbidity to the mother; and if the womb is already septic and the woman's strength is good, Cæsaro-hysterectomy may be elected, with the possibility of improving the prognosis.

In rupture of the uterus, if the rent is incomplete and the fœtus has not escaped into the abdominal cavity, craniotomy may properly be elected. After the child has been extracted the tear may be tamponed with iodoform gauze. Where the child or the greater part of the ovum has escaped from the uterus, making the fœtal parts accessible, embryotomy must give place to abdominal section.

In concluding, the author believes that the choice should be between Cæsarean section and embryotomy in high degrees of pelvic contraction; and as accurate and early diagnosis and pelvimetry become more common the field of mutilation will become more limited.

CHAPTER XXXIV.

CÆSAREAN SECTION. PORRO OPERATION. SYMPHYSIOTOMY.

CÆSAREAN SECTION.

CÆSAREAN section is an operation for the delivery of the child at term by means of an incision through the abdominal and uterine walls.

It is commonly assumed that Cæsarean section takes its name from Cæsar, who is said to have come into the world in this way. Pliny, however, derives the term from the Latin *cædere*, "to cut," and mentions several other celebrities of ancient times, among them Scipio Africanus and Manlius, as being among the number of "*Cæsones*," as they were called.

The practice of Cæsarean section belongs to prehistoric times. A Roman law, ascribed to Numa Pompilius, forbade the burial of a pregnant woman before the fœtus had been taken away from her, and this was generally done through an abdominal incision.

It having been once shown that many children were saved in this way after the death of the mother, the question arose whether it would not often be right in cases of protracted labor, and where the life of the child, although not that of the mother, was threatened, to perform Cæsarean section. The proposal, however, met with bitter opposition. It was urged that to open the abdomen of the mother, even when her condition is hopeless, in order to save the child, is a criminal procedure, and Virchow cites an instance in which a physician was prosecuted for performing Cæsarean section on a dying woman, with the hope of saving the child.

The first recorded Cæsarean section on the living woman was performed in the year 1500 in Switzerland, by one Jacob Nufer, a butcher, who is said to have saved the life of his wife in this way. It is further stated that he operated many times. The procedure subsequently passed from the hands of the butchers into those of the barbers.

In Germany, Trautman was the first to deliver a child through an incision in the uterine wall. He operated in 1610, in a case of hernia of the gravid uterus. In 1881 Rousset published a treatise in French on this subject, and cited nine cases, to which six were added by Casper Bauhin in his Latin translation of Rousset's work. Many authors have since tried to prove that these were not cases of genuine Cæsarean section, but were simple laparotomies for ectopic pregnancies. It is difficult to believe that operation for extra-uterine pregnancy could have been so common in those days.

A great deal of discussion has been directed to the treatment of the uterine wound. In former times the uterine wound was left unsutured. Sänger has done great service by the introduction of a secure uterine suture.

Porro recommended that the older operation should be supplemented by the removal of the uterus.

Indications. The indication for Cæsarean section may be (1) absolute and (2) relative.

Cæsarean section on the living woman should be undertaken in cases in which there is no prospect that the fœtus, even after embryotomy, can be extracted by the natural passages with less danger to the mother. In pelves measuring 6.5 cm., about 2½ inches, in the conjugate diameter with a living child, or 5 cm., 2 inches, with a dead child, Cæsarean section is necessary to save the mother's life. Here the indication is absolute, because no other less dangerous alternative presents itself. It is said to be relative when the operation is elected in preference to other possible methods of delivery.

Even in pelves with a conjugate diameter of 6.5 to 7 cm., elective Cæsarean section is a better operation than its alternatives. Its mortality in elective operations should not exceed 5 per cent. for the mothers and the same for the children. While the maternal mortality of induced labor is practically nil, the infant death-rate from prematurity is about 33 per cent. The best results of symphysiotomy are about the same as those of Cæsarean section for the mothers, but the infant mortality is greater; but the best results are not possible in pelves below 7 cm. Embryotomy is not entirely without maternal death-rate, and the children are all sacrificed.

With a conjugate diameter of more than 7 cm. choice must be made between Cæsarean section, induced labor, symphysiotomy, and craniotomy. The prognosis for induced labor in slight contraction is better than in the class of pelves last considered, since the viability of the child is greater. When the time for induced labor has passed the choice of operation lies between Cæsarean section and symphysiotomy. When the mother is exhausted by long labor and repeated attempts at delivery or is otherwise in bad condition for abdominal section, symphysiotomy offers the best prospect. It may be elected in advance of labor as an alternative of Cæsarean section in very moderate degrees of contraction. When the child is dead or non-viable or a monster, craniotomy should be performed in the interest of the mother. In all other conditions and at the hands of an operator trained in abdominal surgery the Cæsarean operation may be performed.

We believe with Williams, of Baltimore, that the upper limit for the absolute indication for Cæsarean section should be advanced to 7 cm., and the relative indication to 8.5 cm. for flat, and 9 cm. for generally contracted pelves. Williams holds that Cæsarean section should be performed in preference to symphysiotomy in minor degrees of contraction in which forceps or version is inadequate. He would, therefore, when the relative indication is present, allow the labor to go on for one hour in the second stage, and would then elect Cæsarean section in preference to high forceps on the movable head, or to version if the head fails to sink into the pelvis after moulding.

An examination should always be insisted upon before the eighth month of pregnancy, to decide whether narrowing of the pelvis exists. If the measurements of the pelvis are determined in good time, we shall be able to select our method of procedure, and thus be better prepared to meet any emergency.

The time at which the operation should be performed is just before the end of pregnancy. By the history and symptoms, and by accurate measurements combined with palpation, it is possible to decide approximately when the fœtus is mature. It is not necessary to wait until labor-pains come on to ensure contraction of the uterus after delivery; neither is it necessary to wait for marked dilatation of the cervix to insure drainage from the uterine cavity afterward. Sometimes, for obvious reasons, the surgeon may be compelled to operate during labor.

Preparation. In addition to the usual dressings and accessories the instruments needed for the operation are:

1. Scalpels;
2. One dozen artery-forceps;
3. One pair of scissors;
4. A large thin-walled rubber tube as a uterine ligature;
5. Needles threaded, with carriers;
6. Needle-holder.

A careful chemical and microscopical examination of the urine should have been made previously on more than one occasion. The patient should have been kept, if possible, under observation for some time. The bowels should have been carefully regulated.

On the evening preceding the operation the abdomen should be prepared aseptically as for an ordinary cœliotomy. The abdomen and pubes are shaved, and a compress of bichloride (1 : 1000) is applied and kept on until the patient is brought to the operating-table.

The Operation. After being anæsthetized, the patient should be placed on the table with the buttocks resting upon the perineal pad. The healthy vagina in the gravid woman needs no disinfection. If diseased it should be cleansed thoroughly by scrubbing with soft soap on a ball of absorbent cotton held in stout forceps, every fold being exposed. It may afterward be irrigated with a 10 per cent. solution of creolin. About a drachm of iodoform and boric acid powder (1 : 7) may then be thrown up into the vault of the vagina, the cavity being afterward filled with a pack of iodoform gauze. In health all interference within the vagina should be omitted. The toilet of the abdomen is completed in the usual manner.

The operator may by external examination obtain a clear idea of the position of the child in the uterus. Just before the final cleansing of the abdomen the strength and frequency of the fœtal pulse should be noted.

The upper abdomen, the chest, the thighs, and the flanks are covered with sterilized towels; a large piece of gauze of four thicknesses covers the whole body from the chest to the knees, a slit being cut in it from the navel to the symphysis. If the head is wedged in the pelvis, the towels and gauze which cover the upper part of the thighs should be so arranged that an assistant may exercise upward pressure with the hand through the vagina during the extraction of the child.

The operation is often done in from twenty to twenty-five minutes; sometimes it takes three-quarters of an hour.

The length of the abdominal incision must be greater when the uterus is to be brought out of the wound before opening it, than when it is incised *in situ*. With the former method the uterus can be kept under better control, and it is easier to prevent the entrance of fluids into the abdominal cavity. But against this must be put the great length of the incision, which presents the following disadvantages: (1) an extensive scar, with consequent weakening of the abdominal walls, often followed by hernia; (2) the greater extent of adhesions occurring later between the uterus and the abdominal wall, which are likely to be in proportion to the size of the cicatrix. Upon this point Zweifel lays great stress. With the second method an incision of 15 cm., 6 inches, will usually be sufficient, and this shorter incision is generally to be preferred. The description which follows will deal, therefore, more especially with a Cæsarean section in which the uterus is incised and evacuated *in situ*. The rubber ligature is now adjusted by passing its loop over the fundus and tying it lightly by a single knot around the isthmus.

The uterus is incised from the fundus to a point just short of the retraction-ring. The incision is carried boldly through the whole thickness of the uterine wall, notwithstanding the bleeding, which may be quite free. The incision extends from a point about 2½ cm., 1 inch, below the umbilicus to within a similar distance from the symphysis. The abdomen is opened by first cutting through the skin and fascia and separating the muscles by blunt dissection. An assistant, with a pair of forceps, now catches and raises a small portion of the peritoneum, and the operator, with a second pair, takes hold of another portion at a point a short distance from the first pair. A nick is then made between the two forceps, and the operator, having introduced the finger into the opening and using it as a guide, cuts through the remainder of the peritoneum. The uterus is now brought into view, and an elastic ligature is passed over the fundus and placed around the lower segment. The two ends are held by an assistant, who exercises traction, compressing the uterus and fixing it against the symphysis. The latter procedure serves two purposes; it keeps the uterus steady and at the same time prevents excessive hemorrhage.

The location of the placenta may usually be determined before incision of the uterus. When the round ligaments are far apart converging downward the placenta is upon the anterior wall. When the reverse is the case the placental insertion is upon the posterior wall. It was formerly taught that the incision through the uterine wall should always be made to one side of this area, but with our present methods this precaution is unnecessary.

If the placenta lies in the way, it is the usual practice to detach the edge and push it to one side. Time is saved and no more bleeding is occasioned by cutting rapidly through it. When the placenta does not underlie the incision, the membranes will be seen pouting through the incision and presenting a blackish appearance.

The assistant now presses the abdominal wall toward the sides of the uterus, and the operator, passing his hand through the membranes into the uterine cavity near the fundus, grasps the nearest fœtal extremity and, drawing it out, rapidly extracts the child.

A leg may be seized if it can readily be found, or the child may be delivered by the buttock. As a rule, the extraction of the child is easily and speedily effected by grasping the head with both hands. Usually the uterus now contracts, and bleeding is in the main controlled.

Fritsch recommends a transverse uterine incision at the fundus. Jewett has operated by this method, in two cases. Müller opens the uterus at the fundus, but longitudinally instead of transversely. The chief advantage of the fundal incision is greater security in closing the wound. It insures the avoidance of the lower non-contractile portion of the uterus, in which it is difficult to close the wound securely. The median longitudinal incision between the fundus and the ring of Bandl is almost universally preferred.

While an assistant holds the child in a large piece of sterilized gauze, the operator applies two clamps to the umbilical cord and cuts between them. The child is then handed over to an assistant and the stump of the cord is ligated at leisure.

When this has been done, the hand, inserted into the uterus, grasps the fœtal surface of the placenta. The fingers are then closed upon it, squeezing it like a sponge. In this way it is freed from its uterine attachment and gradually withdrawn, the membranes peeling off from the uterine wall.

The uterine wall has thus far been protected by the amniotic membranes from risk of infection. If left untouched, it remains aseptic. No douching and no dusting with antiseptic powders is required. As a rule, the hemorrhage will be slight; but should it be excessive the flow may be controlled temporarily by an assistant, who should grasp the uterus below the body or tighten the ligature around the lower segment.

The objection to tightening the rubber ligature primarily lies in the fact that tight and prolonged constriction may paralyze the nerves and favor uterine relaxation and subsequent hemorrhage. The uterus should be stimulated to contract by friction and by the application of hot towels, and, if need be, by faradism. The same object is promoted by the subcutaneous injection of a half drachm of fluid extract of ergot immediately before the abdominal incision. Oozing may be checked by the application of cheese-cloth sponges wrung out of hot water.

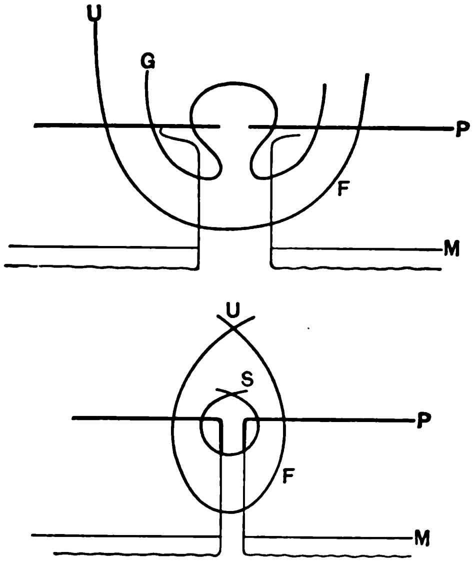
The contracted uterus may now be lifted out of the abdominal cavity and laid upon a large piece of sterilized gauze, which also serves to prevent protrusion of intestines. Or the uterus may better be sutured *in situ*, without removal from the abdomen.

The uterine incision is closed with a row of deep or catgut interrupted sutures, half-deep sutures being inserted between for accurate approximation. Finally, a row of superficial sutures is so placed as to cover in the deep layers. (Fig. 435.) The first sutures should be laid at intervals of about 1.5 cm. apart, being introduced on the peritoneal surface of the uterus about half a centimeter from the edge and brought out on the wound surface just where the decidua and muscularis come together. The line of separation is easily recognized. They are then entered on the opposite surface of the wound at corresponding points and brought out on the peritoneal surface of the uterus on a line with their points of entrance. If hemorrhage is still going on, these sutures should be tied as soon as possible after their introduction, until the bleeding points are reached and the flow is controlled.

Each suture is tied firmly enough to bring the surfaces snugly together and stop hemorrhage from the wound as well as from the suture-punctures. Slight blanching of the surrounding tissues at the point of entrance and exit will show when the sutures are tight enough. If they are too tense, the circulation will be completely cut off from the wound and the risk of septic infection will be rendered greater by the decreased resistance thus produced. The half-deep or superficial sutures are next inserted.

The deep sutures are completely covered in and concealed by the introduction of a layer of superficial sutures along the whole length of the wound. Each of these is made to enter and emerge on the peritoneal surface just outside the line of the deep sutures, and should include just enough tissue to secure a firm hold. The suture is then carried across the incision and through a fold of peritoneum on the opposite side. The peritoneum is thus drawn over the deep sutures, forming a welt which covers the wound in the uterus. This method of suturing the serosa is analogous to the intestinal sutures devised by Czerny and Lembert.

FIG. 435.



Diagrams to show the placing of sutures in the uterine wound after Cæsarean section. (SANGER.) P. Peritoneum. F. Uterine fibre. M. Mucous or decidual layer. U. Deep uterine sutures. S. Superficial serous suture.

The row of superficial sutures provides against the invasion of the peritoneal tract better than any other method, and is especially useful where the labor has been prolonged and forceps or other manipulations have been employed, whereby the patient has become much exhausted. After all the sutures have been introduced, if everything has gone right, the wound surface should remain dry.

Instead of the foregoing method Palmer Dudley uses running catgut sutures in two or three tiers.

The uterus being now drawn forward, the gauze covering the intestines is removed and the peritoneal surfaces are cleansed of blood and liquor amnii by gently pressing them with a dry cheese-cloth sponge. Particular attention should be paid the renal fossæ, a fresh, clean sponge on a holder being carefully carried up into each. The surface of the intestines and of the pelvic cavity behind and in front of the uterus and broad ligaments should also be sponged clean. The uterus, if it has been lifted out, is now replaced within the abdomen, with its anterior surface facing the abdominal wall.

For future reference it is well to make a direct internal measurement of the conjugata vera, using for the purpose a sterilized sound.

The omentum should be brought down in front of the uterus.

After the uterus has been replaced the abdominal wound is closed by means of a continuous fine catgut suture for the peritoneum, interrupted silk-worm gut sutures being employed to bring together the fascia and overlying structures and, if needed, subcuticular sutures also for the skin.

The occlusive abdominal dressing is applied and held in place by a suitable bandage.

The vulvar orifice having been relieved of its pad, the urine is drawn, after which the vulva is covered with a loose pad of absorbent cotton; this is changed every three or six hours.

AFTER-TREATMENT. The after-care of the patient is very important. It may be necessary to give one or two hypodermic injections of morphine, $\frac{1}{3}$–$\frac{1}{4}$ gr., to insure the patient a good rest on the first night. After the first twenty-four hours there will be but little pain, and the hypodermic injections under ordinary circumstances must not be continued. The child should be put to the breast after twenty-four hours, and subsequently at regular intervals of two hours during the day, and once or not at all at night.

The bowels of the patient should be opened on the third day.

As soon as she is able, she may be allowed to pass her water, and after each act of urination the parts should be cleansed by irrigating with boric acid solution.

The subcuticular suture if non-absorbable may be removed about the tenth day and the silk-worm after fourteen days. After two weeks the patient may be lifted out of bed and allowed to remain for a short time each day in a reclining-chair. During the third week she may sit up for a part of the day, and during the fourth week may begin to walk. An abdominal bandage may be worn for several weeks or months.

It is important to determine the position and size of the uterus two or three months after the operation, and to ascertain whether fixation to the abdominal wall exists.

In addition to the foregoing, the following points in the technique of the operation are worthy of mention:

1. In private practice the operation is most frequently performed at the patient's home, and since to-day we ought to preserve almost equally well our aseptic technique in a private house as in a hospital, care should be taken that all necessary preparations are made beforehand, and not left till the operation has begun. In this way the different steps may follow one another with the utmost rapidity consistent with accuracy and attention to detail.

2. If the uterus has probably been infected before operation, the conservative Cæsarean section is not sufficient, and the whole organ must be removed.

3. Drainage must be provided by way of the vagina.

THE PORRO OPERATION.

Porro preferred to supplement the ordinary Cæsarean section by amputating the uterus in its lower segment, the tubes and ovaries being also removed. The advantages claimed for this operation, which is more mutilating than the one just described, are as follows:

1. There is no risk of hemorrhage from the uterine incision either during or after the operation;

2. The woman will never again be put in the same dangerous situation.

Indications.

The Porro-Cæsarean section is indicated, therefore:

(1) When the labor has been prolonged, the membranes have been ruptured for some time, and manipulations have been undertaken involving the uterus which make the occurrence of sepsis very probable.

(2) In the presence of active gonorrhœal infection.

(3) When the uterus or appendages are diseased to such an extent that a subsequent operation will certainly be necessary for their removal.

(4) In pelvic contraction or obstruction in the soft parts, rendering the delivery of a subsequent child impossible, it is justifiable, with the consent of the patient and her relatives, to prevent by Porro's operation the recurrence of pregnancy, which has already proved so dangerous. Failure of uterine contractions after Cæsarean section may necessitate hysterectomy.

The **technique** of the operation is, in the first steps, the same as in the one just described. After the extraction of the child the uterus is eventrated, and the ligature around the lower segment of the uterus is tied tightly to control the circulation. The uterus is cut rapidly away at a point 2½ or 3 cm. above the ligature, and the tubes and ovaries are also removed. The operation is completed by ligating the ovarian vessels and each of the uterine vessels in the stump. The part of the uterine cavity above the rubber ligature is disinfected with pure carbolic acid, applied by means of absorbent cotton on an applicator.

In the original Porro operation the abdominal wound is closed down to the stump, the peritoneum around the lower angle of the wound being attached by a running suture on all sides to the pedicle, thus completely shutting off the peritoneal cavity.

The stump is kept from retracting into the abdominal cavity and slipping out of the knot by forcing two sterilized knitting-needles through the rubber ligature and the stump. These needles rest upon pads which protect the surface of the abdomen.

This method of procedure has been superseded by the subperitoneal method of hysterectomy as commonly practised in supravaginal amputation of the non-gravid uterus. For a detailed account of the procedure, text-books on gynecology may be consulted.

Vesical disturbances do not arise generally in these cases, there being abundant room in which the bladder can expand.

SYMPHYSIOTOMY.

Symphysiotomy (from *σύμφυσις*, a joint, and *τομή*, a cutting) is an operation for the artificial division of the pubic symphysis in woman in labor, in order to increase the diameters of a narrowed pelvis, and thus to permit the birth of a living child through the genital canal.

History. The operation was performed on a dead woman, in place of a post-mortem Cæsarean section, for the purpose of saving a living child, by Jean Claude de la Courvée, at Warsaw. The date is variously given as 1644 and 1585. A similar operation was performed by Joseph Plenck in 1776. That a separation of the pelvic bones exists during the later months of pregnancy was recognized even in the early days of medicine, and allusions to it can be found in the works of Hippocrates and Avicenna. Galen held that the pubic symphysis was a true joint, while Vesalius taught that the pelvic bones were united by cartilage. In 1519 Jacques Amboise conducted a careful autopsy on the body of a woman who had been executed a few days after labor, for child-murder, and demonstrated that a separation of the pelvic bones existed, with no sign to show that it was other than a normal physiological condition. Séverin Pineaud, who assisted at the examination, deemed the findings of such importance that he incorporated them in a brochure, which, however, was not published till 1775. The symphysis was found to be markedly affected, the synchondrosis being much softened, owing to an apparently physiological succulence of the tissues, which was ascribed to pregnancy.

It was, no doubt, the knowledge that a certain degree of separation or relaxation of the pelvic joints exists normally during pregnancy, which suggested the possible advantage of the operation upon the living woman. Such a procedure is certainly an attempt at a close following of Nature's own method of preparing the pelvis for the passage of the child, and goes only a step farther in that it makes disruption of a joint where nature has provided only a relaxation.

Although the credit of proposing the operation on the living woman, with the intention of delivering a viable child, belongs to Réné Sigault, who, while yet a student in Paris, advocated the procedure in 1768 before the French Academy, an Italian surgeon, Domenico Ferrara, who had been in Paris, and who was acquainted with Sigault's views, was first to carry out the suggestion. Ferrara operated in Naples, in 1774. The woman died. Sigault himself performed his first symphysiotomy in 1777, at Paris. The patient was a soldier's wife, who had previously given birth to four children, all born dead. The conjugate was said to have been about 6.5 cm, 2½ inches. The operation was successful, and the woman had so far recovered in two months that she was able to leave her house and was presented for examination by Sigault at a meeting of the Faculty of Medicine. The Academy of Surgeons, with Baudelocque at its head, bitterly opposed the new operation. Their position was strengthened by the facts that Sigault's patient was left with a vesico-vaginal fistula, and that she also suffered from prolapse of the vaginal walls and of the uterus, and had an unsteady, waddling gait. In spite of this relatively ill success and the condemnation of the procedure in high places, Sigault was hailed by many as a public benefactor, and several similar operations were performed. Although the results by themselves would go to show that the hostility of the French surgeons was not without some show of reason, it must be remembered that: (1) the limits of the operation had not been worked out;

(2) methods of pelvimetry were crude and imperfect, and it could not be otherwise than that the operation would be applied in unsuitable cases; (3) cases, many of them ill chosen, were operated upon under different circumstances by various surgeons, some of whom did not possess the requisite skill. In the light of modern discoveries it is to these factors that in a great measure must be ascribed the high rate of mortality in the mothers, which was even exceeded by the fatalities in the case of the children. Sigault himself operated 6 times, and lost 1 mother and 5 children. De Cambon operated 4 times, and lost 1 mother and 2 children. Leroy operated 4 times, and lost 1 mother and 1 child.

Harris' statistics show that in 105 symphysiotomies performed between 1777 and 1866 the maternal mortality was 31 per cent., while 15 per cent. of the children died. Neugebauer records 136 cases between 1776 and 1866, 56 of which were performed in Italy. Of these 56 cases, 22 mothers recovered, and 18 died; in 16 the results are not recorded. Of the children, 16 were born alive, 22 died; in 16 the results are uncertain. Between 1815 and 1841 Galbiati operated 18 times. From about 1820 to 1890 the operation was almost entirely confined to Naples. Harris states there were no reported cases between 1858 and 1865, when Bellozi, of Bologna, operated, but lost the mother. Morisani, of Naples, in 1866, working in the same hospital in which Ferrara had performed his first symphysiotomy, carried out the procedure successfully; mother and child both survived. From this time the operation began to be more generally employed, though up to 1890 the majority of all symphysiotomies had been done at Naples by Morisani and his pupils. Harris, writing in 1883, says that in the seventeen years preceding more symphysiotomies were performed in Italy than in the rest of the countries of the world put together. In 1881 Morisani published 50 cases, with 80 per cent. of successes, 41 mothers and 41 children surviving. In 1885 the same authority published 18 additional cases: 10 mothers and 13 children living.

In 1891 Spinelli, a pupil of Morisani, went to Paris to lay the results obtained at Naples before the French profession. Between 1888 and 1891 he collected 24 cases, out of which 24 mothers and 23 children were saved. His results and those of Morisani made a favorable impression upon Pinard, who became an earnest advocate of the operation, and performed 19 symphysiotomies in something over a year, saving 19 women and 16 children.

The first reported case in America was performed by Jewett, who operated on September 30, 1892. Barton Hirst, of Philadelphia, did the operation a few days after Jewett.

Symphysiotomy was introduced, in the main, as an alternative for Cæsarean section. The maternal mortality in the latter, as originally practised for over eighty years, had been approximately 100 per cent., and it can hardly be wondered that any procedure which promised better results should be hailed as a godsend. The history of all new operations was repeated. Cases were subjected to symphysiotomy where the conjugata vera was so small, or where the pelvis was so deformed, that, as Baudelocque demonstrated, it was impossible to make the head engage after division of the symphysis. Such cases were manifestly out of the province of symphysiotomy. Again, the technique of the operation was faulty. The bladder and urethra were often injured. The peritoneal cavity was in many instances laid open, and sepsis was a frequent result in these early operations. In some of the fatal cases, even where the conjugata vera did not measure under 2½ inches, 6.5 cm., the sacro-iliac joints were found ruptured and filled with pus.

Present Status of the Operation. Since the advent of antiseptic surgery the statistics of the operation have greatly improved. In 210 cases operated on since 1886,[1] 12.85 per cent. of mothers and 20.2 per cent. of children died. These operations were performed by all sorts of surgeons, possessing varying degrees of skill, dexterity, and surgical judgment. If the results of the best operators be taken by themselves, the mortality will be found to be much less. Morisani, for example, in 55 cases lost 3.5 per cent. of mothers and 5.5 per cent. of children. Zweifel, of Leipsic, whose former condemnation of the operation has already been referred to, in 31 cases lost 4 children and no mothers.

Bar in 22 cases saved all the mothers and all the children. Küstner in 7 symphysiotomies had no maternal or fœtal deaths. In 8 cases operated upon by Jewett, 7 of the mothers made good recoveries, 1 died of œdema of the lungs a few hours after operation. All the children but one were delivered alive, though not all of them survived the first month.

Indications for the Operation. The field of symphysiotomy has in recent years become a very limited one. This is due in part to defects inherent in the operation, in part to the steadily improving status of Cæsarean section.

Symphysiotomy does not effect delivery, but merely prepares the way for it. The anatomical limitations of the operation are very narrow, and exact measurements of the pelvis—and especially of the child's head *in utero*—are impossible. The proper selection of cases for pubic section is attended with difficulty and symphysiotomy in a pelvis too small is a grave mistake for mother and child. Cæsarean section, on the other hand, ensures immediate delivery in all cases irrespective of the degree of contraction.

Symphysiotomy, however, may be performed in cases in which the operator can be assured that only a little more pelvic space is required for delivery. It affords a means of saving both patients in conditions in which the judicious use of forceps has unexpectedly failed. Forceps, indeed, should always be tried before resort to pubic section.

It is indicated, too, in certain cases of pelvic contraction within the limits already mentioned when the mother is too much exhausted to permit abdominal section. Here the prognosis of symphysiotomy is good for both patients, while the mortality of the Cæsarean operation is formidable when performed after long labor or repeated attempts at delivery by forceps or version.

Symphysiotomy is indicated: (1) In simple flat pelves with a conjugata vera between 7.5 and 9 cm., 2.8–3½ inches. (2) In generally contracted pelves with a conjugata vera between 9 and 10 cm., 3.2–3.9 inches. These rules presuppose that the head of the child is of normal size. (3) Jewett, with others, finds an application for symphysiotomy. In mento-posterior face presentations which are irreducible. (4) In cases of impaction in occipito-posterior presentations; version and the employment of the forceps here are often more dangerous to mother and child than symphysiotomy.

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[1] Neugebauer, 1893, Ueber der Rehabilitation der Schamfugentrennung, etc.

Briefly, the operation occupies a field just beyond the scope of forceps. Its chief rival in cases of the same degree of pelvic narrowing may be said to be embryotomy. In any but slight degrees of pelvic contraction it cannot take the place of Cæsarean section. Symphysiotomy or the Cæsarean operation should replace perforation of the living child almost wholly.

Symphysiotomy is contraindicated in ankylosis of one or both sacro-iliac joints and by infection of the uterus. In the latter condition Cæsarean section followed with hysterectomy offers the best chance for the mother.

Rationale of the Operation. As has been said, the operation depends for its success upon the lengthening of the conjugate and the general enlargement of the area of the superior strait. When the pubic symphysis, together with the subpubic ligament, is divided and the pubic bones are separated from each other, they not only move outward from the median line, but also downward in a direction toward the feet. This is due to the fact that the axis of rotation at the sacro-iliac joints is not parallel to the long axis of the body, but runs from without inward and from above downward.

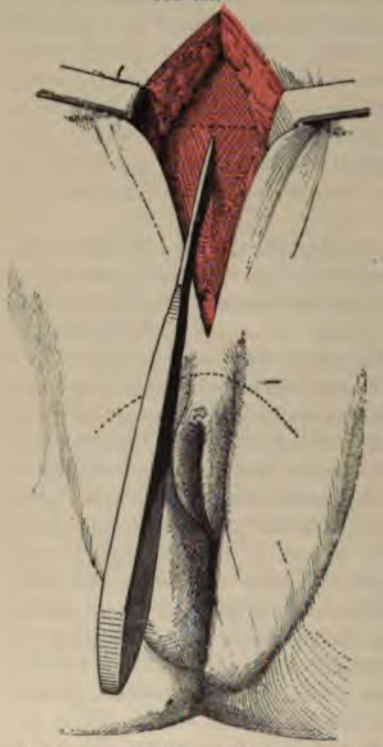
This peculiarity of rotation has been well explained by Wehle, who compares the separation of the pelvic halves very aptly to the opening of a pair of double doors. Should the doorposts be vertical and the axis of rotation vertical, the under surface of the doors, when opened, will describe a plane perpendicular to the axis of rotation and tangential to the earth's surface, the lower outer angle of the door neither descending from nor approaching the floor; but should the doorposts be set at an angle from above downward and inward toward each other, then the doors, when opened, will still describe a plane perpendicular to the axis of rotation, but directed in each case from within outward and downward. The downward movement of the pubic bones, with the accompanying nutation of the sacrum, of itself increases the length of the conjugata vera.

A separation of 3 cm., 1.1 inches, causes a descent of 2 cm., 0.7 inch, and the fœtal head pressing upon the ends of the separated bones drives them still further downward. Another important thing to keep in mind is the fact that the anterior prominent part of the child's head, which in the majority of cases is one or other of the parietal prominences, is received in the space between the sundered bones. We see, then, that the canal for the passage of the child is rendered larger in three ways: (1) by separation of the ends of the bones, (2) by downward movement of the ends, and (3) by the accommodation of a prominent part of the child's head in the interpubic space. With a pubic separation of 7 cm., the total gain in the antero-posterior diameter is about 1.3 cm.; in the transverse the gain is one and a half, and in the obliques about twice as much as in the conjugate.

Technique of the Operation. The woman should be prepared as for an abdominal section. The pubic hair should be carefully shaved, and all parts in the neighborhood of the field of operation rendered as aseptic as possible. The bladder should be empty. The operation is best delayed, when consistent with safety, until the birth canal has been prepared by nature as far as possible for the passage of the child. The cervix should be fully dilated or dilatable and the vagina should be ample. If dilatation is not complete it should be made so before operation.

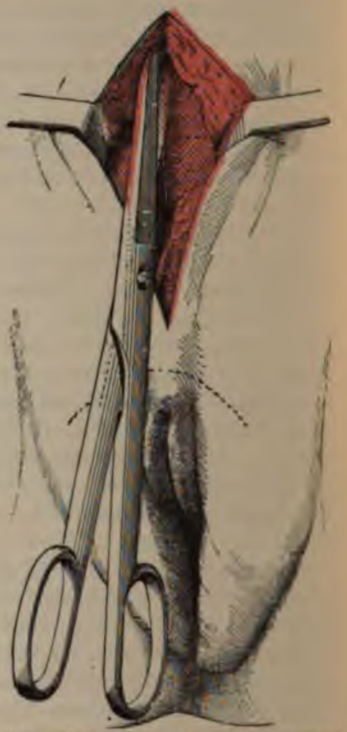
The patient is placed upon her back on the table, with the thighs flexed and somewhat everted. This position can be maintained by means of a suitable leg-holder. Two assistants must steady the thighs and prevent undue separation of the lateral halves of the pelvis after section of the symphysis. The exact situation of the symphysis should be determined, and should be indicated by a mark,[1] and it is advisable to draw a transverse line showing the situation of the subpubic ligament, which can usually be detected easily by the finger below or to one side of the clitoris. An assistant introduces a full-sized metallic catheter into the urethra. This is depressed as a whole, carrying with it the urethra out of the way of the knife; the catheter serves also at the same time to keep the bladder empty. An incision is made beginning about 3 cm., 1½ inches, above the symphysis and extending downward about three inches to the clitoris. The edges of the wound are separated by retractors, and with a few touches of the knife the linea alba is laid bare.

FIG. 436.



Preliminary incision of the outer covering between the recti with the cutting surface of the scalpel. (FARABEUF.)

FIG. 437.



Extending with scissors the opening made by the scalpel. (FARABEUF.)

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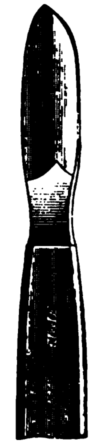
[1] A fine camel's-hair brush dipped in tincture of iodine or a solution of silver nitrate serves the purpose.

(Figs. 436 and 437.) When the exact position of the symphysis cannot readily be determined, it is well to make gentle traction on the clitoris, the suspensory ligament of which is attached to this point and can be made to serve as a guide. The next step is to separate the suspensory ligament of the clitoris, taking care not to wound the dorsal vessel, and to draw the clitoris down and out of the way, until the lower surface of the arch of the pubes is brought into view. By careful dissection the upper part of the symphysis is next exposed. A finger is then inserted between the recti muscles, and the symphysis is freed posteriorly, the tissues being pushed away from it. A broad, flat, grooved director or guard, strongly bent on the flat, is then inserted under guidance of the finger behind the symphysis, either from above downward or from below upward. (Figs. 439 and 440.) The function of this guard, which should be kept close to the symphysis, is to protect the tissues behind it from injury. The section of the symphysis may then be made either from within outward (Fig. 441), or, as Farabeuf advises, from without inward. Farabeuf uses a short, thin knife. (Fig. 438.) The external ligamentary tissues are first divided, then the periosteum, and finally the cartilage. The periosteum should not be stripped off the bone, except for a very short distance. Other methods of dividing the symphysis may be preferred. After laying bare the joint and opening the linea alba between the recti muscles a thin, probe-pointed, narrow-bladed bistoury, passed downward on a finger as a guide through the abdominal incision, may be employed to sever the joint, the cut being made from behind forward. Galbiati's knife, or Harris's modification of this instrument, may be used, instead of a bistoury. Bleeding is controlled, and a provisional dressing of sterilized gauze is packed into and over the wound.

FIG. 438.



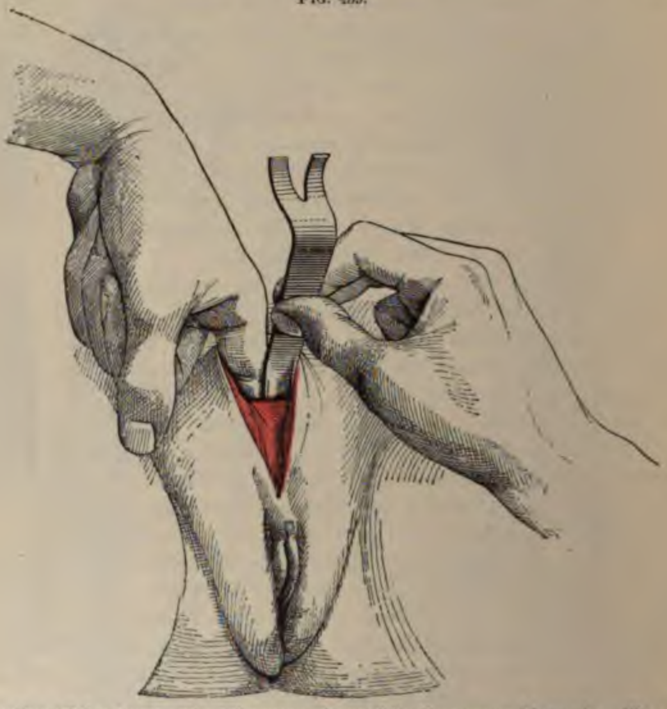
Knife of Farabeuf.

Ayers prefers the following subcutaneous method of dividing the symphysis pubis, and reports four successful cases. The procedure is somewhat as follows: The clitoris having been raised from the symphysis, a narrow, sharp-pointed scalpel is passed beneath it through the mucous membrane from below upward, in the line of the symphysis, to within about half an inch of the upper border of the pubes. The tissues of the joint are then cut through with a straight, blunt-pointed bistoury. In order that the bladder and urethra should not be injured during the procedure they are pushed to one side by means of a sound; at the same time a finger in the vagina controls the blunt point of the bistoury while the tissues of the joint are being divided.

Authorities differ as to whether or not forcible separation of the ends of the symphysis should be made. Some French authors, notably Farabeuf, advise that it be done at once, thus preventing needless compression of the child's head. It would seem more reasonable, with Caruso, to support the hips by a sterile bandage and allow the process to go on more slowly. This plan is attended with less risk of serious laceration of the birth-canal and more nearly approaches the conditions attending a normal labor. The pubic bones should not be allowed to separate further than 6.5 or 7 cm., 2.5–2.7 inches; if this limit be not exceeded, no great harm can be done at the sacro-iliac joints.

It must be kept in mind that while the separation may be within these limits, it may be due entirely to the downward and outward movement of one side, the other side not partaking in the rotation upon the sacral axis. The danger in allowing a larger amount of separation than 7 cm., 2.7 inches, lies in the fact that the anterior ligaments of the sacro-iliac joints and the tissues in the immediate neighborhood may be very extensively ruptured. A small amount of laceration in these tissues, as has been said, does no harm. If a separation of 7 cm., 2.7 inches, or thereabouts is produced, and if this has been accomplished at the expense of one sacro-iliac joint, serious disruption may ensue in this joint, although the total amount of separation at the symphysis be well under the limit. To guard against this the operator should attend personally to the separation at the pubes, and see that both ossa innominata are equally and gently rotated outward. Should one be rotated further out than the other, the situation can readily be detected by observing that one pubic end is lower than the other, whereas they should both be on the same imaginary line drawn perpendicularly to the long axis of the body. Care must be taken, during the passage of the child through the pelvis, that the structures anterior to the birth-canal be protected with due care, especially if any further operative procedures

FIG. 439.

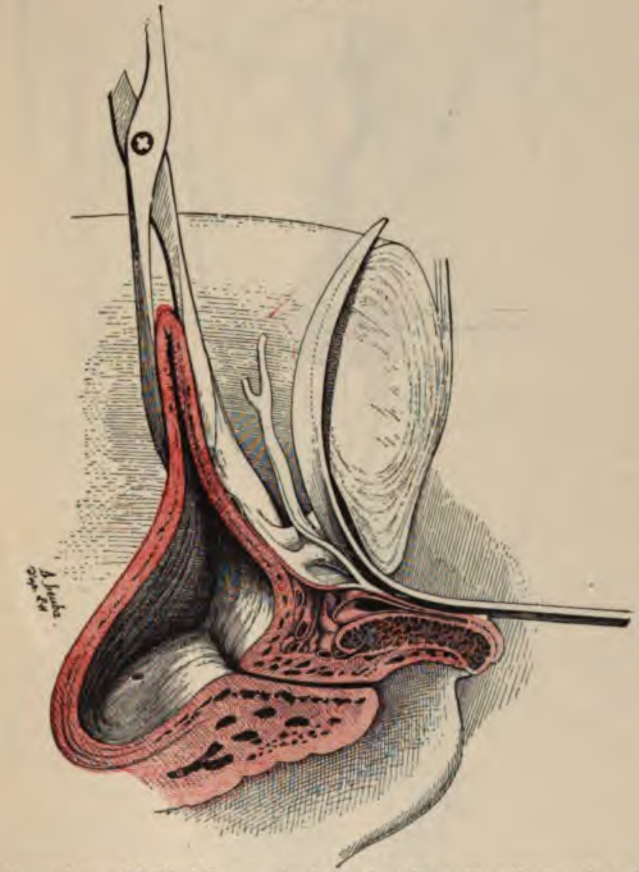


Introduction of the finger and of the grooved guard by the suprapubic route. (FARABEUF.)

with the forceps or version be resorted to. It must be remembered that the posterior structures have the support of the sacrum, the coccyx, and the levator ani, but that those situated anteriorly have practically lost their only support.

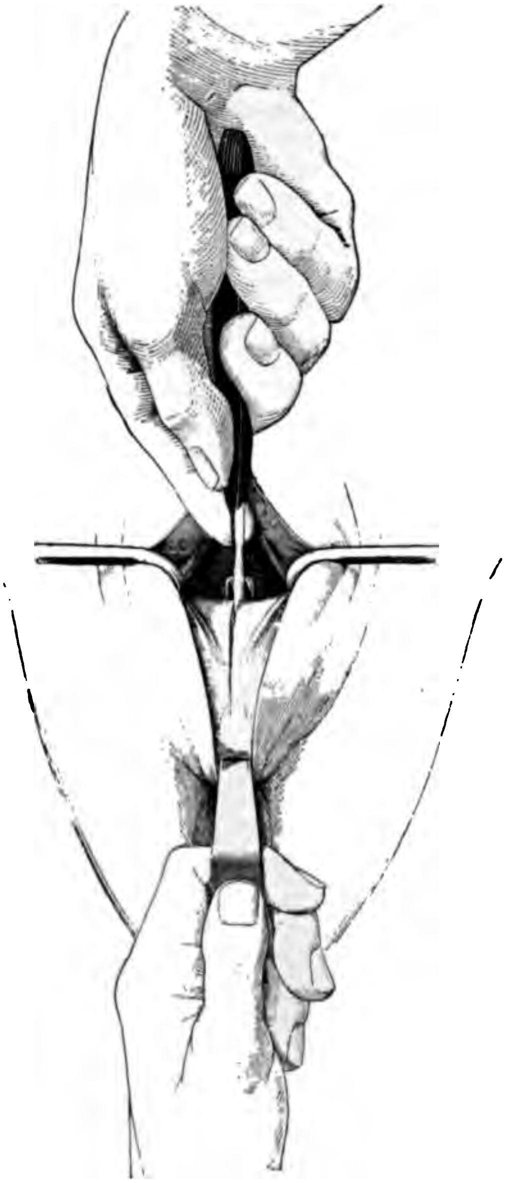
During delivery it is well to protect the field of operation, more especially the incision and the immediate neighboring parts, from possible infection. This can best be done by packing either plain sterilized gauze or iodoform gauze into and around the wound. This dressing can be retained in position by a firm, sterile canton-flannel binder. In fact, this procedure serves several other ends. The gauze packing in the wound, while stopping oozing, or even more active bleeding, gives at the same time considerable support of a yielding character to the bladder, urethra, and anterior structures. The flannel binder serves to support the ossa innominata, and while preventing the divided bones from separating too far, allows them to give enough to permit the passage of the child.

FIG. 440.



The grooved guard passed behind the symphysis, employed to protect the vessels and organs from the knife during the incision. (FARABEUF.)

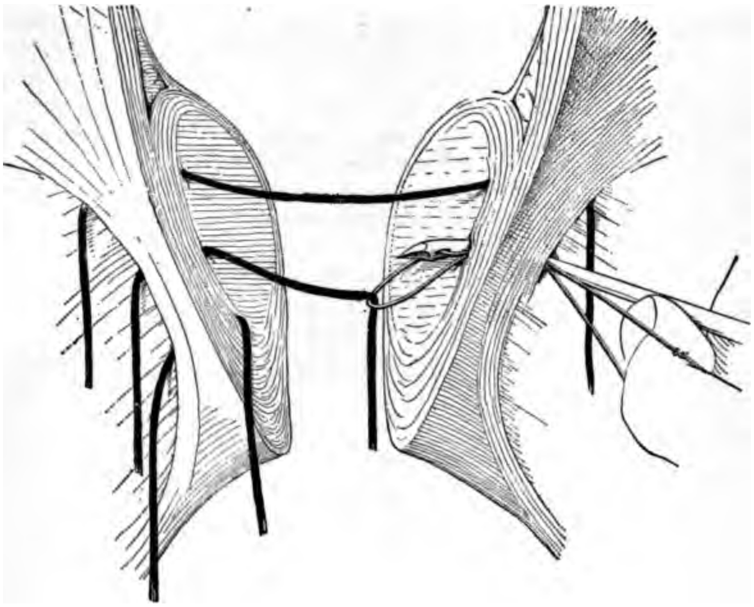
Fig. 441.



Symphysiotomy. The division of the symphysis is accomplished (1) by section between the recti muscles, to sever as far as possible the hard, creaking bundles of the fibrous covering, and to trace in front a line corresponding to the groove of the guard, which is held firmly against the ridge corresponding to the articulation behind. (2) By means of a short, narrow blade with a rounded extremity the operator then cuts through the symphysis from above downward, with the cutting edge of the blade directed forward and under the protection of the grooved guard. (Farabeuf.)

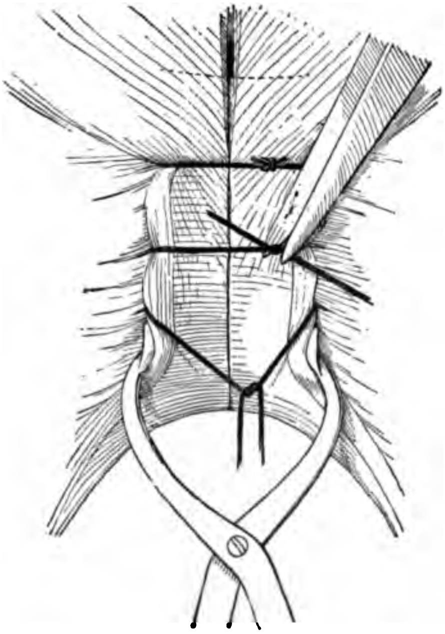
Extraction with forceps is generally advisable if the child is not promptly expelled spontaneously.

Fig. 442.



Mode of introduction of sutures. These should be of strong silk, and should be inserted from e outer borders of the longitudinal bands, keeping close to the bones. It is best to begin on the ght side, which presents the greatest difficulty. (Farabeuf.)

Fig. 443.



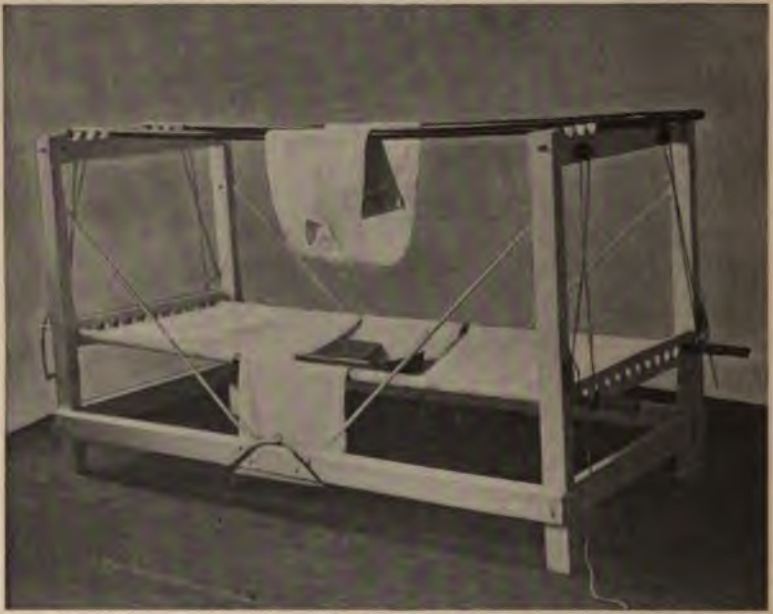
Tying the sutures, while the bones are held in place by Farabeuf's forceps. (Farabeuf.)

After delivery the wound should be closed. Bone sutures are unnecessary and inadvisable. Retention is ensured by suturing the prepubic fibrous structures and applying a firm pelvic binder, especially if coaptation is favored by the use of a trough bed or hammock sling during convalescence.

A simple suture of silk-worm gut embracing all the structures down to the bones, or a crossed or figure-of-eight suture of the same material may be employed. In the latter plan the deep loop of the suture brings together the fibrous structures, and the remaining loop closes the superficial portion of the wound.

If preferred, the aponeurotic structures in front of the bones may be brought together with chromated catgut and the rest of the wound closed in any of the methods usually practised for the abdominal wound.

FIG. 444.



Ayers' symphysiotomy hammock (empty), showing arrangement of canvases, bedpan, etc.

If the bladder is ruptured, it should be sutured, and careful after-attention given to see that the viscus does not become distended and allow the occurrence of extravasation of urine. In such case the complete or incomplete closing of the external wound must be left to the judgment of the operator.

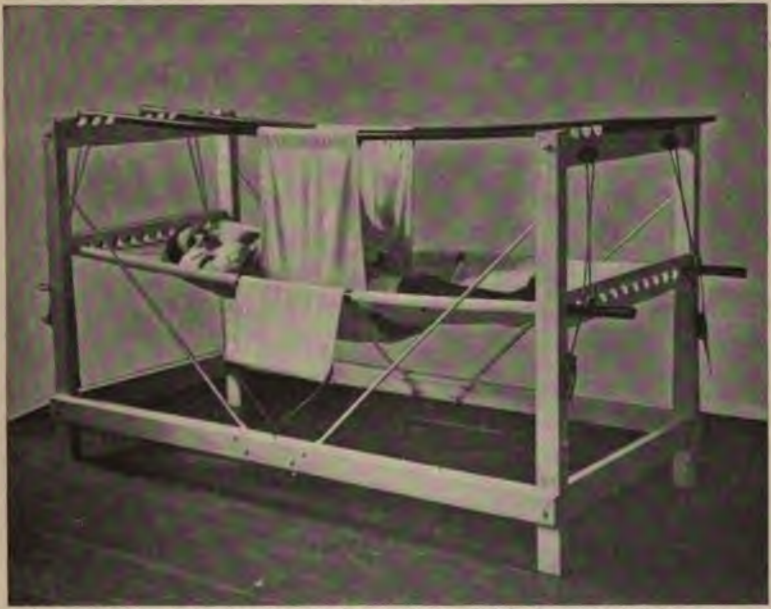
After the wound has been dressed aseptically the pelvis is encircled with two or three firm straps of adhesive plaster which overlap posteriorly. A strong canvas binder is then applied, the bony prominences being protected with padding. The binder needs constant attention to keep it tight. It should be changed if soiled.

Pinard uses a gutter-shaped bed or mattress, and places cushions under the lateral halves of the body. Jewett and others adopt practically the same method, using an ordinary, rather hard mattress and keeping the patient on two firm cushions or sand-bags placed under the lateral halves of the pelvis and extending nearly to the shoulders.

When the bedpan is used the greatest care should be exercised by the nurse to see that no movement on each other of the anterior ends of the bones is permitted. It is best to have ready a strong, intelligent assistant to support the pelvis and gently lift the buttocks while the nurse slips the vessel beneath.

An excellent apparatus for maintaining coaptation of the pubic bones after symphysiotomy is Ayers' hammock-bed. This consists of a canvas stretcher supported as shown in Figs. 444 and 445. The stretcher may be made more or less trough-shaped by the adjustment at less or greater distance apart of the poles on which it hangs. A canvas sling wide enough to reach well above and below the pelvis is suspended by its ends from a second pair of poles above the first. When adjusted for use the loop of this pelvic sling reaches the stretcher. The patient rests with her pelvis in the loop of the sling, while the remainder of her body is supported by the stretcher. It will be seen that the pubic bones are held firmly in apposition by the action of the sling, while the upper portion of the body and the lower extremities lie comfortably upon the stretcher.

FIG. 445.



Ayers' symphysiotomy hammock, showing patient. Pelvis is supported by upper poles. Lower poles and hammock support head, chest, and limbs, and is adjusted to level of upper hammock.

In the Dresden clinic patients are provided with a pelvic support, and are allowed to get up after three weeks. It would seem that this is too early to allow the patient to assume the erect position; in any case, it is wiser to keep her fully six weeks in bed, treating the case as one would a pelvic fracture or a fracture of the femur. The pelvic support should not be discarded for several weeks after the woman leaves her bed.

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